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THE COMPUTATION OF HINDU DATES IN INSCRIPTIONS, &c.

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Introductory.

If we compute the moment of expiry of a *tithi* by the elements of two or more *Siddhântas*,[1] the results may differ by an hour or even more. This difference will affect the calculated date only where the end of the *tithi* falls near the beginning or end of a day. But in such cases even a small difference may carry the end of the *tithi* to the preceding or following day, and thereby change the date by a whole day. For these cases, then, it is desirable to be able to compute the *tithi* according to more than one *Siddhânta*. Besides, the moment of the *Saṁkrânti*, or the true beginning of the solar month, varies with the different authorities, and this difference may affect the name of the lunar month according as the new-moon falls before or after the beginning of the solar month;[2] and hence the necessity of tables for all available *Siddhântas*.

2. The following tables are based, as far as possible, on the Hindu solar year. This arrangement recommends itself by facilitating the finding of the lunar month, and by abridging the calculation of the *tithi*.

3. A close study of the subject proves that the several *Siddhântas* furnish the elements on which a date depends nearly correct (*i.e.* compared with the results of modern science) for the time of their composition. Some *Siddhântas* yield tolerably correct results for a long period extending over several centuries, while others diverge sooner from the truth. Now of course it is always uncertain which *Siddhânta* was followed by the unknown almanac-maker who furnished the date recorded in any historical document; but it may be presumed that he used the *karaṇa* most in vogue, *i.e.* one which was not very old, and which therefore yielded correct results for the time being. These considerations have induced me to construct a General Table in which the value of the quantities necessary for the calculation of dates, *viz.* the relative position of sun and moon, and the moon's anomaly, are set down in accordance with modern science.

4. The General Table is to be first used; and only when by that table the end of the *tithi* falls very near the beginning of the day, and the week-day comes out in error by one day only, need the Special Tables for the several *Siddhântas* be tried to see if one of them will furnish the desired result.

[1] The tables published by me in the *Indian Antiquary*, vol. XVII, pp. 147—181, are based on the *Sûrya Siddhânta* as now current. They yield therefore the end of a *tithi*, the principal item of a Hindu date, in accordance with that *Siddhânta* only.

[2] My previous tables give the beginning of the solar month according to the *Ârya Siddhânta* only; the present furnish the same also according to the other *Siddhântas* available to me.

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Hindu Chronology.

5. The difficulties which beset the verifying of Hindu dates are of two kinds: one, caused by the strictly astronomical basis of the calendar, will be as far as possible removed by the present tables. The other is due to the intricacy of the calendar system, which is further enhanced by the variety of usages adopted in different parts of India as regards some of the elements. It may therefore be convenient to preface these tables by a short description of the principles of Hindu chronology.

The Solar and Lunar Calendars.

6. The solar year is the same all over India. It commences with the instant of the sun's entrance (*Saṁkrânti*) into the Hindu sign of Mesha—Aries, which is, at the same time, the beginning of the solar month Vaiśâkha. The beginnings of the other solar months are similarly determined by the entrance of the sun into the different zodiacal signs (see Table III). The moment of the entrance (*Saṁkrânti*) however is not the same if calculated according to different authorities, but this calculation is reduced to a very easy process by the tables. The solar years are recorded in the era of the Kaliyuga, the years of which are converted into those of the Christian era by subtracting 3101 from the number of complete years elapsed since the beginning of the Kaliyuga; and, *vice versâ*, the corresponding complete, or expired, year of the Kaliyuga is found by adding 3101 to the Christian year.[3]

7. The items of the solar calendar most frequently recorded in documents are the Saṁkrântis, which, as stated above, are identical with the true commencements of the several solar months; and of which the Makara-Saṁkrânti is also called Uttarâyaṇa-Saṁkrânti, because with it the sun enters upon his northern course, and the Karkaṭa-Saṁkrânti is called the Dakshiṇâyana-Saṁkrânti, because with it the sun enters upon his southern course.[4] Otherwise the solar calendar is seldom used by itself; a knowledge of it however cannot be dispensed with, as the solar year is the scale by which the lunar calendar is regulated.

8. A lunar month corresponds to one lunation. It is reckoned either from new-moon to new-moon, or from full-moon to full-moon. The first scheme is called the *amânta*, *darśânta*, or southern scheme; the latter the *pûrṇimânta* or northern scheme.[5]

9. Each month consists of two *pakshas*, usually translated by 'fortnight'. The bright fortnight (*śukla*, *śuddha* or *sita paksha*, or *śudi*, *sudi*, *śuti*) is the period of the waxing moon; the dark fortnight (*krishṇa*, *bahula* or *asita paksha*, or *badi*, *vadi*, *vati*) that of the waning moon. As indicated above, the bright fortnight in the *amânta* or southern scheme is the first *paksha* of the month; in the *pûrṇimânta* or northern scheme, it is the last. But in either case it denotes the same space of time. It is different with the dark fortnight; for the dark fortnight of an *amânta* month corresponds to that of the following month in the *pûrṇimânta* scheme, *e.g.* the dark fort-

[3] It should however be kept in mind that the Christian year does not quite correspond to the year of the Kaliyuga. For, roughly speaking, the three first months of the corresponding Christian year belong to the preceding year Kaliyuga; and the same months of the following Christian year form the end of the given year of the Kaliyuga.

[4] Compare however § 39, on the tropical *Saṁkrântis*.

[5] Though the *pûrṇimânta* or northern scheme is decidedly the older of the two, yet for practical reasons the lunar tables are primarily intended for the *amânta* scheme.

night of Chaitra in the *amânta* scheme is the dark fortnight of Vaiśâkha in the *pûrṇimânta* scheme, and *vice versâ*.

10. The name of the lunar month is now invariably determined by the new-moon forming the true beginning of its bright fortnight. For the lunar month takes the name of the solar month in which that new-moon occurs, *e.g.* the new-moon in the solar month of Chaitra always inaugurates the bright fortnight of the lunar month Chaitra.[6] If two new-moons occur within one solar month, there will be two lunar months of the same name: the proper one (*nija*) and the intercalated one (*adhika*).[7] In the south the intercalated month precedes the proper one; in the north it is inserted between the two *pakshas* of the proper month. Usually, however, the two homonymous *pakshas* are marked *prathama* and *dvitîya*. If no new-moon occurs in a solar month, there will of course be no lunar month of that name, and that month is considered expunged (*kshaya*).[8]

11. Each *paksha* is divided into fifteen *tithis*. A *tithi* is the time required by the moon to increase its distance westward from the sun by twelve degrees of the zodiac. As the true motions of the sun and the moon vary with their position in their orbits, the length of a *tithi* is variable; but the General Tables enable us to determine the limits of any *tithi* within about one *ghaṭikâ* (24 minutes) of the truth, and the Special Tables to within about a *pala* (24 seconds).

12. The *tithis* are named or numbered by the Sanskrit ordinals—*prathamâ*, *dvitîyâ*, &c., up to *pañchadaśî*, but the 15th *tithi* of the bright half is also called the full-moon *tithi*—*paurṇamâsî*, and the 15th *tithi* of the dark half, the new-moon *tithi*—*amâvâsî* or *amâvasyâ*;[9] and the first *tithi* of either half bears the name *pratipad* or *pratipadâ*. The instants of new and full-moon are the terminal points of the dark and bright fortnights. In civil reckoning, the *tithis* are coupled with the civil days in such a way that the civil day (from true sunrise to sunrise) takes the name, *i.e.* number of that *tithi* which ends in it; *e.g.* *Mâgha-śuddha-pañchamyâm* (usually abbreviated Mâgha-sudi 5) means the day on which ends the 5th *tithi* of the bright fortnight of Mâgha.

13. It sometimes happens (on an average once in $63\frac{10}{11}$ *tithis*) that two *tithis* end in one civil day; in that case the *tithi* which falls within the civil day is considered as expunged (*kshaya*), and the day is named (or numbered) after the first *tithi* ending in it, the name (or number) of the second being omitted in the numbering of the civil days; *e.g.* if *tithi* 5 and 6 end in one day, that day is called the 5th, and the following day the 7th. On the contrary, if a *tithi* begins on one day, runs over the following, and ends on the next again, the day on which no *tithi* ends takes the same number as the preceding day, which is thus repeated (*adhika* or *dvitîya*); *e.g.* if the 4th *tithi* ends on one day, and the 5th on the day next but one, the three days are numbered respectively 4, *adhika* or *dvitîya* 4, and 5.

[6] It is evident that generally only a part of the lunar month falls in the eponymous solar month; in the *amânta* scheme the last part of the lunar month extends into the next solar month; in the *pûrṇimânta* scheme either the beginning of the lunar month falls in the preceding solar month, or the end of the lunar month in the following solar month.

[7] According to a verse quoted from Brahmagupta, a lunar month which begins and ends in the same solar month receives the name of the *preceding* solar month. This custom however has long since gone out of use. See Fleet's *Corp. Inscr. Ind.* vol. III, p. 88, note 5.

[8] According to Warren (*Kalasankalita*), its name is compounded with that of the following month.

[9] For full-moon and new-moon form the *end* of the bright and dark fortnights respectively.

14. In connexion with civil reckoning it may be remarked here that the Hindus have adopted the planetary week current in Europe since about the 2nd century A.D. The Indian week-days are named in the same order as ours, *Ravivâra*, *Somavâra*, *Maṅgala* or *Bhaumavâra*, *Budhavâra*, *Guruvâra*, *Śukravâra*, *Śanivâra*, being our Sunday, Monday, &c. In documents, the week-day is frequently noted together with the lunar date, which enables us to verify the latter. The mean civil day is divided into 60 *ghaṭikâs*, of 60 *palas* each. The *ghaṭikâ* is therefore = 24 minutes, and the *pala* = 24 seconds.[10]

15. Astronomers begin the lunar year with the new-moon in Chaitra; and this reckoning also prevails in Northern India. It will be remarked that the beginning of the lunar year thus falls in the middle of the lunar month of Chaitra according to the *pûrṇimânta* scheme, the first or dark fortnight of Chaitra belonging to the preceding year. In the *amânta* scheme, however, the beginning of the lunar year coincides with that of the month. In Southern India the lunar year usually begins seven months later, *i.e.* with new-moon in solar Kârttika. The part of the year from Kârttika to Phâlguna is the same in the north and south of India; but the months Chaitra to Âśvina of the southern year stand one year in advance of the northern account.

16. The most common eras in which the lunar years are reckoned are the Śaka[11] and Vikrama eras. By adding 3044 to the Vikrama year and 3179 to the Śaka year, the concurrent year of the Kaliyuga is found. The northern lunar year coincides with the concurrent solar year (K.Y.), except in the first part (of varying length) of the lunar month Chaitra, which always falls in the preceding solar year; but of the southern lunar year only the first part, *viz.* Kârttika to Phâlguna, coincides with the concurrent solar year,—the lunar months Chaitra to Âśvina falling in the following year.

17. Usually the year given in a date means the *expired* year, *e.g.* Śaka 735 means in full phrase "after 735 years of the Śaka era had elapsed," and the year denoted is actually the 736th year current. In conformity with this, the tables always give expired years. The Hindus however occasionally use the current year, the number of which is, of course, in advance by one of the expired years.

18. In interpreting a date, we must keep in mind all possible cases. The year may be either the expired or the current year; it may be either the northern or the southern lunar year; and the date may be recorded either in the northern (*pûrṇimânta*) scheme, or in the southern (*amânta*) scheme. Therefore, if the first calculation of a date yield an unsatisfactory result, we must try the other possible cases before deciding upon it[12]

[10] The sidereal day which is shorter than the civil day by about 10 *vinâḍîs* or *palas* (correctly 3 minutes 56·555 seconds) is divided into 60 *nâḍîs*, each of 60 *vinâḍîs*, each of 6 *asus*. The difference between civil and sidereal time may be neglected, whenever the time is sufficiently small, say less than 3 *ghaṭikâs* This will always be the case in this paper. Correctly speaking, the Hindus employ true civil time, so that the *ghaṭikâs* are not of invariable length. This difference, however, may safely be neglected in the operations with which we are concerned.

[11] It may perhaps be worth while to note that in Śaka 0, the mean solar year began with full-moon.

[12] I subjoin in a tabular form the various ways in which, as Professor Kielhorn has shown (*Ind. Ant.* vol. XIX, page 22), a date may be interpreted—

I. Dates in the five months from Kârttika to Phâlguna—
- (*a*) dates in bright fortnights; two possible cases:
  - (1) expired year,
  - (2) current year;
- (*b* dates in dark fortnights; four possible cases: expired year and current year according to both the *pûrṇimânta* and *amânta* schemes.

II. Dates in the seven months from Chaitra to Âśvina—
- (*a*) dates in bright fortnights; three possible cases:
  - (1) northern year current,
  - (2) northern year expired = southern year current,
  - (3) southern year expired;
- (*b*) dates in dark fortnights; six possible cases: the same three years according to both the *pûrṇimânta* and *amânta* schemes.

The Tables: the Julian Calendar.

19. The tables are based, as far as possible, on the Hindu solar calendar; but for simplicity a solar calendar is employed in them in which the dates may differ by one day from the Hindu solar dates. As the Hindus scarcely ever used the solar calendar by itself, this difference is of no practical moment; in the sequel, however, will be shown how the true solar date may be elicited from the tables. It is only necessary here to show how a date in the tables may be converted into the corresponding Christian date, old style. For this purpose the subjoined tables may be used.

PART I.—CURRENT CENTURIES OF THE KALIYUGA.

Century .	31	32	33	34	35	36	37	38	39	40
Equation .	0	1	2	3	3	4	5	6	7	8
Century .	41	42	43	44	45	46	47	48	49	50
Equation .	9	10	10	11	12	13	14	15	16	16

PART II.—ODD YEARS OF THE CENTURY K.Y.

For the years 1, 2, 5, 6, 9, 10, 13, 17, 21, 25, 29, 33, 37, 41, subtract 1.
„ „ „ 72, 76, 80, 84, 88, 92, 96, add 1.

Years not entered here take the equation of the century without any alteration.

PART III.—FOR HINDU MONTHS.

Vaiśâkha *14th March*	Jyaishṭha 14th April	Âshâḍha *15th May*	Śrâvaṇa 16th June	Bhâdrapada *17th July*	śvina *17th August*
Kârttika 17th September	Mârgaśira *17th October*	Pausha 15th November	Mâgha *14th December*	Phâlguna *13th January*	Chaitra. 12th February.

Chaitra of preceding year K.Y.	Vaiśâkha of following year K.Y.	NOTE.—If the date falls in a common Julian year, the first date should be taken; if in a leap year, the second.
12th February C.Y. 13th February L.Y.	14th March C.Y. 13th March L.Y.	The italicised months contain 31 days.

20. *Rule for finding the Julian date corresponding to a date in the Tables*: *Ex.* 1. for 3940 K.Y. 25th Bhâdrapada. Take the equation of the century K.Y. from Part I, in this case 7; make the alteration prescribed by Part II, here none; add the result to the Julian date placed below the given Hindu month, here 7 + 17 = 24th July. This is the Julian date corresponding to the first day of the solar month, which in the table is numbered 0. Add to the above result the number of the given day, here 25; the sum is the corresponding date of the given day, *viz.* 24 + 25 = 49th July, *i.e.* 18th August. Accordingly 3940 K.Y., 25th Bhâdrapada is A.D. 839, 18th August, O.S.

Example 2: 4237 K.Y., 28th Mâgha.
10 — 1 = 9. 9 + 14th December + 28 = 51st December 1136, *i.e.* 20th January, 1137, O.S.

Example 3: 4584 K.Y., 13th Kârttika.
12 + 1 + 17th September + 13 = 43rd September, *i.e.* 13th October A.D. 1483, O.S.

21. *To find the date corresponding to a given Julian date*: *Ex.* 1: A.D. 839, 18th August. Convert the year A.D. into the corresponding year K.Y. by adding 3101. (Take care, however, to select the year K.Y. in which the Julian date actually falls); 839 + 3101 = 3940 K.Y. Take the equation of the corresponding year K.Y. *viz.* 7. Add it to a date in Part III, so that the sum, or resulting date, is still less or earlier than the given Julian date: 17th July + 7 = 24th July = 0 Bhâdrap. and if July 24th = 0 Bhâdrap. the 18th Aug. (25 days later) must be 25th Bhâdrapada, 3940 K.Y.

Example 2: 1137 A.D., 20th January. The date falls in 4237 K.Y. 10 — 1 = 9. 14th December or 0 Mâgha + 9 = 23rd December.
20th January = 51st December. 51 — 23 = 28th Mâgha 4237 K.Y.

Example 3: 1483 A.D., 13th October.
4584 K.Y. 12 + 1 = 13. Kârttika 0, or 17th September + 13 = 30th September; 13th October = 43rd September. 43 — 30 = 13th Kârttika.

Description and use of the General Tables.

22. Tables I-IV serve to verify lunar dates coupled with the week-day. The tables are based on the solar calendar, and indirectly indicate the lunar date. This must always be borne in mind in order to understand the application of the tables.

Tables I and II refer to the years of the Kaliyuga. Table I contains the centuries; Table II the complete odd years of the century; Table III gives the days of the solar months approximately; and Table IV, the *ghaṭikâs* of a whole day.

To the right of the Index the three columns headed Feriæ (*i.e.* week-day), Tithi, and 'moon's mean anomaly', furnish the elements on which the verification of a lunar date depends.

23. *To convert a date of the tables into a lunar date*:—First convert the given year of the Śaka, Vikrama (or other) era into the corresponding year of the Kaliyuga, by applying the proper equation. As an example take—Śaka 1503, Vaiśâkha-sudi 11 Friday. Here we have 1503 + 3179=4682 K.Y.

The quantities contained in the columns in the different tables must be summed up, *e. g.*, with the date 4682 K.Y. 18th solar Vaiśâkha, we proceed as follows:—

			Fer.	Tithi.	☽'s an.
By Table	I	4600	(0)	17·60	15
„ „	II	82 years	(5)	7·09	971
„ „	III	18th Vaiś.	(1)	15·26	544
	Sum. 4682K.Y.	18th Vaiś.	(6)	39·95	560

The week-days are counted from Sunday=1 (Saturday being 7 or 0). Therefore, if the Feria is greater than 7 (or 14), retrench 7 (or 14); the remainder indicates the week-day. In this case it is the 6th, or Friday.

24. The *tithis* are counted from 0 to 30, the order of the numbers being that of the *amânta* scheme; 0 to 15 are the *tithis* of the bright fortnight, 15 to 30 (or 0) those of the dark fortnight. Therefore, if the sum of the *tithis* is greater than 30 (or 60), retrench 30 (or 60). In this case we have 39·95—30 = 9·95. This is the sum of the complete *tithis* elapsed and the decimal fraction of the current *tithi*, at the moment to which the tables refer, *viz.* the beginning of the day of Hindu astronomers, *i.e.* mean sunrise at Laṅkâ (supposed to be situated on the Equator under the prime meridian). *Tithi* 9·95, therefore, means that 9 complete *tithis* and 0·95 of the tenth *tithi* of the bright fortnight have elapsed at mean sunrise at Laṅkâ. If the *tithi* (or remainder)

is above 15, retrench 15; the remainder indicates the complete *tithi* of the dark fortnight, *e.g.* 17·60 denotes that 2·60 *tithi* of the dark fortnight have elapsed.

This, however, is not the true *tithi*, but always less, and a correction must be applied to obtain the true *tithi*. This correction, which is always *additive*, depends on the mean anomaly of the moon, which is here expressed in thousandth parts of a revolution. Therefore, if it exceeds 1000, the first figure, if it has more than three, is to be rejected. With the remainder as argument turn to the Auxiliary table III, and take out the equation for this argument. The equation added to the mean *tithi* gives the true *tithi*.

Thus the data already found, *viz.*, (6) 9·95 560 :—

☾'s an. 560, gives equation	+ 0·26
true *tithi* . .	10·21

Accordingly, on the day under consideration, which was a Friday (as shown by Fer. = 6), the 11th *tithi* was running at mean sunrise at Laṅkâ. Of the 11th *tithi* 0·21 had elapsed, 0·79 *tithi* being wanting to complete it. Table IV shows that 0·79 *tithi* is equal to about 46 *ghaṭikâs*. Accordingly the 11th *tithi* ended at about 46 *ghaṭikâs* after mean sunrise at Laṅkâ, and therefore that day (18th solar Vaiśâkha) was *sudi* 11. New-moon occurred about 11 days before the 18th solar Vaiśâkha, or on the 7th; and since it fell in solar Vaiśâkha, it commenced the lunar month of Vaiśâkha. The lunar date corresponding to 18th Vaiśâkha 4682 K. Y. is therefore Vaiśâkha-*sudi* 11, Friday.

Example 2 : 4327 K. Y. 22nd Pausha.

	Fer.	Tithi.	☾'s an.
4300 K. Y.	(0)	27·78	251
27 years	(6)	28·76	908
22nd Pausha.	(6)	29·38	617
	(5)	25·92	776
an. 776, eq. =		+ 0·01	
		25·93, or 10·93 of the dark fortnight.	

To find the day of new-moon preceding or succeeding the day under consideration: subtract the *tithi* found, *viz.* 25·92 from the *tithi* of 22nd Pausha, *viz.* 29·38=3·46; on the day whose *tithi* is equal to or near this remainder of 3·46, new-moon occurred. The next preceding new-moon fell on the 26th Mârgaśira; the next following new-moon on the 27th Pausha. Therefore the lunar date corresponding to 4327 K. Y. 22nd Pausha is, in the *amânta* scheme, Mârgaśira *badi* 11, Gurau or Thursday; in the *Pûrṇimânta* scheme—Pausha *badi* 11, Gurau or Thursday.

25. But the problem which the historian is called upon to solve, is the converse of this: *viz.* the *tithi* being given, to find the day on which it ended, or more correctly, the *tithi* and the week-day being given, to find whether they really went together or not in a given year. The majority of dates in all kinds of documents give rise to this question when we have to test their genuineness, or to elicit circumstantial or other general information. The problem must be solved indirectly, *i.e.*, we ascertain approximately the day on which the given *tithi* was likely to end, and then calculate, in the way stated above, the *tithi* that really ends on that day; and the solution of this problem may be so managed that the first approximation leads at once to a definite result. The method will be best explained by an example.

The date 3585 K. Y., Âshâḍha-*sudi* 12, Thursday, being given,—we calculate first the Feria, *tithi*, and ☾'s anomaly for the beginning of the given year, *viz.* 3585, K. Y.

	Fer.	Tithi.	☾'s an.
3500 K. Y.	(1)	25·96	585
85 years	(2)	10·52	747
3585 K. Y.	(3)	6·48	332

We next ascertain the new-moon in solar Âshâḍha, as by it the lunar month Ashâḍha is determined. New-moon being equal to *tithi* 30·00, we find (by subtracting the *tithi* for the beginning of the given year, *viz.* 6·48 from 30) that 23·52 *tithis* have to elapse before the next new-moon. Therefore all days in Table III, whose *tithi* is 23·52 or the next lower figure, are approximately new-moon days in 3585 K. Y. Call 'Index of new-moon,' the difference between the *tithi* for the beginning of the given year and 30, and 'Index of the *tithi*,' the sum of the index of new-moon and the number of the *tithi* given in the date to be verified. In this example the *Index* of new-moon is 23·52, and the *Index* of the *tithi* is 23·52 + 12 = 35·52 or 5·52.

We now look out in Table III, in the column of the given month, for the day whose *tithi* is nearest to, but smaller than, the Index of new-moon. In this case we find that this occurred on the 24th Âshâḍha. We then select the day whose *tithi* is nearest to, but smaller than, the Index of the *tithi*. If the date belongs to the bright fortnight, or if it is a date in the *amânta* scheme, the day selected must be the nearest day pointed out by the index of the *tithi*, which comes *after* new-moon; but if the date belongs to the dark fortnight of the *pûrṇimânta* scheme, the day is to be sought *before* the new-moon day. The date in the present case belonging to the bright fortnight we look out the index of the *tithi*, 5·52, after the 24th Âshâḍha (the day of new-moon); and the *tithi* of the 2nd Śrâvaṇa being 4·70, we select it, and add the corresponding elements to those calculated for the beginning of K. Y. 3585, thus :—

	Fer.	Tithi.	☾'s an.
3585 K. Y. (as above)	(3)	6·48	332
2nd Śrâvaṇa.[13]	(2)	4·70	375
	(5)	11·18	707
☾ an. 707, eq.		+ 0·02	
		11·20	

Accordingly, at the beginning of the day, the 12th *tithi* was current, 0·80 *tithi* being wanting to complete the 12th. Table IV shows that 0·80 *tithi* is equal to about 47 *ghaṭikâs*. Therefore the 12th *tithi* ended on the day in question, about 47 *ghaṭikâs* after mean sunrise at Laṅkâ; that day was a Thursday as the corresponding Feria is (5). It follows that the date—3858 K. Y. Âshâḍha-*sudi* 12, Thursday, is correct, or that in 3858 K. Y. Âshâḍha-*sudi* 12 fell on a Thursday. The above operations may be expressed in the following—

Rules.

26. (1). Sum up Feria, *tithi*, ☾'s *an.* for the century (Table I) and the odd years (Table II) of the Kaliyuga corresponding to the given date. The result is the Feria, *tithi*, and ☾'s *an.* for the beginning of the given year.

[13] Though this notation of the solar day is artificial, still it should always be recorded in the calculation; for it will be of use in some cases, as will be seen in the sequel.

(2). Subtract from 30 the *tithi* for the beginning of the given year. The remainder is the *Index* of new-moon. Add to it (*i.e.* to its complete *tithis*) the number of the *tithi* given in the date; the sum is the *Index* of the *tithi*. It should however be remarked that, if the *tithi* belongs to the dark fortnight, 15 must be added to the above sum to find the *Index* of the *tithi*, both for the *amânta* and *pûrṇimânta* schemes.

(3). Then look out, in Table III, in the solar month synonymous with the lunar month given in the date, the day whose *tithi* is nearest to, but smaller than, the Index[14] of new-moon. Now, if the date belong to the *amânta* scheme, or if it belong to the bright fortnight of either scheme, look out, *after* new-moon day, the day whose *tithi* is nearest to, but smaller than, the index of the *tithi*. But the *tithis* of the dark fortnight in the *pûrṇimânta* scheme precede new-moon. Add the Feria, *tithi*, and ☾'s *an.* of the day indicated by the *Index* of the *tithi*, to the quantities found for the beginning of the given year, and add to the *tithi* thus found the equation for ☾'s *an.* from the Auxiliary Table III. The result shows what *tithi* was current at the beginning of the day at Lankâ. The end of the *tithi* can be found approximately by Table IV.

Ex. 1. Saṁvat 1232 Bhâdrapada-*sudi* 13, Ravau (northern year Saṁ 1232 = K.Y. 4276, Ravau = Sunday = 1.)

	Fer.	Tithi.	☾'s An.	
4200	(1)	2·19	699	Ind. ● or new moon = 30—3·46 = 26·54.
76 years	(5)	1·27	454	Ind. tithi *sudi* 13, is 26·54 + 13—30 = 9·54.
4276 K.Y.	(6)	3·46	153	
3rd Âśvina	(2)	8·83	661	
	(1)	12·29	814	
☾'s *an.* 814, eq. =		0·03		
	(1)	12·32 = Sunday, sudi 13.		

Ex. 2. Saṁvat 1011, Bhâdrapada-*badi* 11, Śukradine (*pûrṇimânta*, northern year), Saṁ 1011 = 4055 K.Y.

	Fer.	Tithi.	☾'s An.	
4000 K.Y.	(1)	8·98	523	Ind ● = 30—17·31 = 12·69.
55 years	(6)	8·33	63	Ind *badi* 11, is 15 + 11 + 12·69 — 30 = 8·69.
4055 K.Y.	(7)	17·31	586	
4th Bhâdr.	(0)	8·31	573	
	(7)	25·62	159	
☾'s an. 159, eq.		+ 0·77		
	(7)	26·39		

Accordingly, at the beginning of Saturday (= 7) the 27th tithi, or the 12th tithi of the dark fortnight, was running; and the 11th *tithi* ended on the preceding day, a Friday, which therefore was the day intended in the date.

Ex. 3. Saṁvat 1236, Vaiśâkha-sudi 15, Śukre, southern year; hence Vaiśâkha does not belong to the corresponding solar year, 4280 K.Y., but to the following year 4281; see above §15.

	Fer.	Tithi.	☾'s An.	
4200 K.Y.	(1)	2·19	699	Ind. ● is 1·52.
81 years	(4)	26·29	725	Ind. *sudi* 15 = 16·52.
4281 K.Y.	(5)	28·48	424	
19 Vaiśâkha	(2)	16·28	581	
	(7)	14·76	5	
☾'s an. 5, eq.		+ 0·43		
	(7)	15·19		

The 15th *tithi* having ended on the preceding day, which was a Friday (6), the date is correct.

[14] We may also take the *tithi* which is equal to the *Index* or even a little larger.

Ex. 4. Saṁvat 1154, Chaitra-sudi 2, Ravau (southern year), Saṁvat 1154=4198 K.Y. Chaitra belonging to the corresponding solar year, K.Y. 4198, we use the second Chaitra of Table III (see § 16).

	Fer.	Tithi.	☾'s An.
4100 K.Y.	(1)	5·58	111
98 years	(4)	3·99	59
4198 K. Y.	(5)	9·57	170
15 Chaitra	(4)	22·52	593
	(2)	2·09	763, eq = 0.

Ind. ● = 20·43
Ind. *sudi* 2 = 22·43

The 2nd *tithi* ended on the preceding day, Sunday, as required.

Ex. 5. Saṁvat 1194, Chaitra-*badi* 5, Gurau. Northern year, *pûrṇimânta.*

We must use the second Chaitra of Table III (see § 15). Saṁvat 1194 = 4238 K.Y.

	Fer.	Tithi.	☾'s An.
4200 K.Y.	(1)	2·19	699
38 years	(6)	0·63	728
4238 K. Y.	(7)	2·82	427
9th Chaitra	(5)	16·42	375
	(5)	19·24	802
☾'s *an.* 802, eq. =		0·02	
		19·26	

Thus the 20th *tithi*, or 5th *tithi* of the dark fortnight, ended on Thursday as required.

If a doubt be entertained, whether the *tithi* actually ended on the day whose *tithi* has been calculated, calculate for the following day; thus—

4238 K. Y.	(7)	2·82	427
10th Chaitra	(6)	17·44	412
	(6)	20·26	839
☾'s an. 839, eq. =		0·07	
		20·33	

Hence at the beginning of Friday (6) the 21st *tithi* was running, and therefore the day could not be *badi* 5.

We may however dispense with a second calculation whenever the running *tithi* is between ·10 and ·90.

27. *Corrections for true time.*—The tables yield the date in mean Laṅkâ time; to convert it into mean local time, add to or subtract from it the difference in time between the prime meridian—that of Ujjain, or 75° 51′ 45″ (5 hours 3 minutes 27 seconds) east of Greenwich,—and the place from which the document is dated, one degree being equal to 6 *vinâḍîs.* If the place lies to the east of Ujjain, the amount must be added; if to the west, it must be subtracted, for local time. Table XXV furnishes, for the principal towns in India, the latitudes, longitudes, and difference in time expressed in *ghaṭikâs* and *palas.* The sign + or — indicates the amount that is additive or subtractive.

28. A second correction (the Equation of time) is required for converting mean local time into true local time. A method for finding the exact value of this correction will be given below. For the present it will be sufficient to know in which way the correction influences the date. The rule is that true local time is in advance of the mean time (*i.e.* the correction is additive) from about solar Vaiśâkha to Kârttika, but behind it (or subtractive) from about Kârttika to Vaiśâkha. The correction is at its maximum about the ends of solar Âshâḍha and Pausha, and at its minimum about the beginnings of Vaiśâkha and Kârttika.

29. *To find the beginning of a solar month.*—Whenever new-moon occurs on one of the three first days of a solar month, *viz.* on one of the three days marked 0, 1, 2, in the

tables, it becomes doubtful whether the new-moon belongs to the current or to the preceding solar month. For the true beginning of each solar month, *i.e.* the instant of the *saṁkrânti*, or entrance of the sun into the zodiacal sign, usually falls near the beginning of the second day of the solar month of the tables, *i.e.* on one of the two days marked 0 and 1; it may however also fall on the day marked 2, and still more rarely on the last day of the preceding month. It will therefore, in these cases, be necessary to ascertain the precise beginning of the solar month. For this purpose the column headed " Solar Cor. " in Tables I and II, and a similar element placed under the names of the solar months in Table III, is used. The figures entered in this column of Tables I and II denote, in *ghaṭikâs* and *palas*, the time by which the beginning of the *mean* solar year (according to the different authorities named in Table I) precedes (—), or follows (+), mean sunrise at Laṅkâ (*i.e.* the beginning of the day throughout these tables) of the 3rd Vaiśâkha of Table III. *E.g.*—According to the *Ârya Siddhânta* the " Solar Cor." for 4000 K. Y. is — 16 *gh.* 40 *p.*; for 30 years—14*gh.* 23*p.*; for K. Y. 4030, therefore, — 16*gh.* 40*p.* — 14 *gh.* 23*p.* or — 31*gh.* 3*p* ; for 36 years + 18*gh.* 45*p.*, for K. Y. 4036 = — 16*gh.* 40*p.* + 18*gh.* 45*p.* = + 2*gh.* 5*p.* These figures denote that the *mean* solar year according to the *Ârya Siddhânta* began in 4000 K. Y. 16*gh.* 40*p.* before mean sunrise at Laṅkâ; in 4030 K. Y. 31*gh.* 3*p.* before; and in 4036 K. Y. 2*gh.* 5*p.* after mean sunrise at Laṅkâ of the 3rd Vaiśâkha of the tables. In Table III the 'Solar Cor.' placed below the names of the several months, as the correction of the month, shows by how much the true beginning of the month is separated from the mean sunrise of the second day of the same month (marked 1 in Table III), the beginning of the mean solar year being supposed to coincide with the beginning of the 3rd of Vaiśâkha. In all other cases the 'Solar Cor.' for the year must be combined with the 'Cor.' of the month, in order to find the true beginning of the latter, *e.g.*, 4030 K.Y. = — 31*gh.* 3*p* ; Âśvina = + 17*gh.* 51*p.*: the sum, — 13*gh.* 12*p.* indicates that Âśvina in 4030 K. Y. began 13*gh.* 12*p.* before the 1st Âśvina in Table III. As however the beginning of the solar year, and consequently that of the solar months, varies with the different authorities, four columns are given under Corrections for Solar dates in Table I, headed by the name of the *Siddhântas* from which the elements are derived. The 'Cor.' in Table II strictly applies only to the *Ârya Siddhânta*, and for other *Siddhântas* it requires a small correction; this however may be neglected in calculations with the General Tables, as the exact calculation can only be made with the Special Tables. In using the *Brahma Siddhânta*, we must use the day 0 of Table III, in place of the day 1, as according to that *Siddhânta* the beginning of the solar year precedes by about one day the beginning of the solar year employed by the other *Siddhântas*.

The " Cor." for the months differs also with the different authorities. It is given according to the *Ârya Siddhânta*[15] and to the *Sûrya Siddhânta*, which yield the greatest and the smallest amounts. As the General Tables give only approximate results, *i.e.* results correct only to within one or two *ghaṭikâs*, it would be needless to strive after greater accuracy in the ascertainment of the beginning of the solar months.

[15] I give the 'Cor.' for the months according to the *Sûrya Siddhânta* as found by the Special Tables; but the 'Cor.' according to the *Ârya Siddhânta* is calculated from the length of the solar months given by Warren. The latter result differs in some cases by more than half a *ghaṭikâ* from my calculations. But as Warren probably gave his dates on the authority of a native tradition, and as the difference is smaller than need be taken into account, I have adhered to his statements.

As the beginning of a solar month is the moment of the *saṁkrânti*, the rules given above serve at the same time for calculating the *saṁkrântis*.

30. *Doubtful cases.*—When the index of new-moon points to one of the first three days of a month in Table III, compute the true beginning of the solar month as above, and then calculate the *tithi* for the moment thus found. The result shows at once whether new-moon followed or preceded the true beginning of the month, and consequently whether that new-moon belonged to the same or to the preceding month.

Rule.—Sum up the *tithi*, ☾'s *an.* and *Cor.* for the given year; add the *tithi* and ☾'s *an.* for day 1 of the given month, and the *Cor.* for the given month. Add to, or subtract from these sums the *tithi* and ☾'s *an.* for the *ghaṭikâs* of the sum of *Cor.* (Table IV) according as the latter has the sign + or —. Then proceed as usual and interpret the result (*i.e.* the true *tithi*) as explained above. This will be best illustrated by examples.

Ex. Suppose a date in Pausha 3844 K. Y. be given, we calculate as usual:—

	Fer.	Tithi.	☾'s An.	
3800 K. Y.	(1)	15·17	348	Ind. ● = 8·37
44 years	(6)	6·46	243	
3844 K. Y.	(7)	21·63	591	

The index of new-moon points to the first Pausha and to the first Mâgha, both these days belonging to the doubtful days; hence it is uncertain whether the first new-moon belongs to Mârgaśira or Pausha, and whether the second belongs to Pausha or Mâgha. We therefore determine first the true beginning of the solar months Pausha and Mâgha. *Cor.* for 3800 is —0*gh.* 50*p.*, for 44 years +22*gh.* 55*p.*; consequently for 3844 K. Y. it is + 22*gh.* 5*p.* Add 'Cor.' for Pausha (+ 9*gh.* 44*p.*) = +31*gh.* 49*p.*, and for Mâgha (+ 30*gh.* 37*p.*) = + 52*gh.* 42*p.* We then add to the result for 3844 K. Y. the *tithi* and ☾'s *an.* for 1 Pausha and 1 Mâgha, and the increase of *tithi* and ☾'s *an.* for the calculated *Cor.* of Pausha and Mâgha.

	Tithi.	An.		Tithi.	An.
3844 K. Y. . .	21·63	591	3844 K. Y. . .	21·63	591
1 Pausha . .	8·11	855	1 Mâgha . .	7·48	908
32 gh. (Table IV) .	0·54	19	53 gh. . .	0·89	32
	0·28	465		0·00	531
☾'s an. 465, eq. .	0·51		☾'s an. 531, eq. .	0·34	
	0·79			0·34	

The true *tithi* for the beginning of both months shows that, in both cases, new-moon had passed; consequently the first new-moon belonged to Mârgaśira and the second to Pausha.

31. *Intercalary and expunged months.*—If in the above example the first new-moon had occurred *after*, and not *before* the beginning of Pausha, there would have been two new-moons in the same solar month, and consequently there would have been an intercalation of Pausha. If on the contrary the second new-moon had occurred *after* the beginning of Mâgha while the first occurred *before* that of Pausha, there would have been no new-moon in Pausha, and consequently lunar Pausha would have been expunged. The preceding remarks lead us to the following rules:—

(1) If at the beginning, as well as at the end, of a solar month, the moon is either waxing or waning: or, in other words, if both the current *tithis* belong either to the bright or to the dark fortnight, there is an ordinary and no intercalary or expunged month.

(2) If the moon is waning at the beginning, but waxing at the end of a solar month there is an intercalary month.

(3) If the moon is waxing at the beginning, but waning at the end of a solar month, the homonymous lunar month is expunged. These rules are expressed in the subjoined scheme.

At beginning of a solar month, and		At end of the same solar month.	
Sudi	and	*Sudi*	ordinary month.
Badi	and	*Badi*	ordinary month.
Badi	and	*Sudi*	intercalary month.
Sudi	and	*Badi*	expunged month.

Examples for intercalary months—

Ex. 1. Saṁvat 1218 (northern year) dvi° Âshâḍha sudi 5, Gurau.

Saṁvat 1218 = 4262 K. Y.

	Fer.	Tithi.	An.		gh.	p.
4200 K. Y.	(1)	2·19	699	Cor.	—32	30
62 years	(1)	25·98	861		+ 2	17
4262 K. Y.	(2)	28·17	560		—30	13

'Cor.' for Âshâḍha, + 10*gh.* 51*p.* added to '*Cor.*' of the year,—30*gh.* 13*p.* makes—19*gh.* 22*p.*; Âshâḍha began 19*gh.* 22*p.* *before* 1 Âshâḍha of Table III. '*Cor.*' for S'râvaṇa,— 12*gh.* 31*p.* added to — 30*gh.* 13*p.* makes —42*gh.* 44*p.*; S'râvaṇa began (or Âshâḍha ended) 42*gh.* 44*p.* before 1 S'râvaṇa of the Table.

	Tithi.	An.
4262 K. Y.	28·17	560
1 Âshâḍha	1·07	177
	29·24	737
—19 gh.	—0·32	11
	28·92	726
☾'s an. 726, eq.	0·01	
	28·93, Moon waning.	

	Tithi.	An.
4262 K. Y.	28·17	560
1 S'râvaṇa	3·68	339
	1·85	899
—43 gh.	0·73	26
	1·12	873
☾'s an. 873, eq.	0·11	
	1·23, Moon waxing.	

Accordingly there was an intercalary Âshâḍha. We now calculate *sudi* 5, of the intercalated month.

	Fer.	Tithi.	An.	
4262 K. Y.	(2)	28·17	560	Ind. ● = 1·83
4th S'râvaṇa	(4)	6·74	448	Ind. *sudi* 5 = 6·83
	(6)	4·91	8	
☾'s an. 8, eq. =		0·44		
	(6)	5·35		

Accordingly the 5th *tithi* ended on the preceding day, which was a Thursday, as shown by its Fer. being (5). The *sudi* 5 of the regular month fell on the 6th Âshâḍha, which was a Wednesday.

Ex. 2. Saṁvat 1298, dvi° Bhâdrapada-*badi* 7, Gurau.

The year being the southern year, Bhâdrapada fell in 4343 K. Y. (not in 4342 K. Y.) See § 16.

We proceed as above—

	Fer.	Tithi.	An.	gh.	p.
4300 K. Y.	(0)	27·28	251	+ 9	35
43 years	(5)	25·66	997	+ 7	24
4343 K. Y.	(5)	22·94	248	+ 16	59

Bhâdrapada Cor. + 15*gh.* 41*p.* + 16*gh.* 59*p.* = + 32 *gh.* 40 *p.*

Âśvina Cor. + 17*gh.* 51*p.* + 16*gh.* 59*p.* = + 34 *gh.* 50*p.*

	Tithi.	An.
4343 K. Y.	22·94	248
1 Bhâdrapada	5·26	464
+ 33 gh.	0·56	20
	28·76	732
An. 731, eq.=	0·00	
	28·76. Moon waning.	

	Tithi.	An.
4343 K. Y.	22·94	248
1 Âśvina	6·80	589
+ 35 gh.	0·57	21
	0·31	858
An. 858, eq.	0·09	
	0·40. Moon waxing.	

Accordingly, there was an intercalation of Bhâdrapada. We calculate the *tithi* :—

	Fer.	Tithi.	An.		
4343 K. Y.	(5)	22·94	248	Ind. ●	7·06
22nd Âśvina	(0)	28·14	351	Ind. *badi*	7=29·06
	(5)	21·08	599		
An. 599, eq.		0·17			
	(5)	21·25			

Accordingly the 22nd *tithi*, or *badi* 7, ended on Thursday (5), as required.

We have selected the day according to the *amânta* scheme, which comes out correctly; had we tried the *pûrṇimânta* scheme, the week-day would not have come out correctly, *viz.* 24th Bhâdrapada, Wednesday, in the first month, 25th Śrâvaṇa, Monday. If we had tried the northern year Saṁ 1298, whose Bhâdrapada fell in 4342 K. Y., we should have found that there was no intercalary Bhâdrapada in that year. As the character of a given date is not usually known beforehand, all these calculations must be made in order to decide the case.

32. Though an expunged month cannot occur in a date, still it may be interesting to see how an expunged month can be proved by calculation to have been due. If it be suspected that in 4012 K. Y., Pausha had been expunged, we calculate the *tithis* and anomaly for the beginning of Pausha and Mâgha: —

	Tithi.	☾'s an.	gh.	p.
4000 K. Y.	8·98	523	— 16	40
12 years	12·67	66	+ 6	15
4012 K.Y.,	21·65	589	— 10	25
1 Pausha	8·11	855		
—10 gh.	—0·17	—6		
	29·59	438		
an. 438, eq.	0·57			
	0·16, Moon waxing.			

		gh.	p.	gh.	p.	gh.	p.
Pausha		— 10	25	+ 9	44=	— 0	49
Phâlguna		— 10	25	+ 30	37=	+ 20	12
4012 K. Y.,	21·65		589				
1 Mâgha	7·48		908				
+ 20 gh.	0·34		12				
	29·47		509				
an. 509, eq.=	0·39						
	29·86, Moon waning.						

The calculation shows that no new-moon occurred in solar Pausha: accordingly Pausha was expunged in the Lunar calendar of 4012 K. Y.

The following general rules will be found useful:—

(1) The months Kârttika up to Phâlguna only can become expunged.

(2) There can never be an intercalary Pausha, and the intercalation of the months Mârgaśira and Phâlguna is possible only under favourable circumstances, depending on the moon's anomaly.

33. It may sometimes be desired to know in which years of a given century a certain month was intercalary. This may best be explained by an example. If it be required in which years of the 40th century of the Kaliyuga, Śrâvaṇa was intercalary: we add the elements of the 40th century to those of the 1 Śrâvaṇa and 1 Bhâdrapada, and calculate them for the beginning of those months in 4000 K. Y., *viz.*—

	Tithi.	☾'s an.	gh.	p.
4000 K. Y.	8·98	523	— 16	40
1 Śrâvaṇa	3·68	339	— 12	31
	12·66	862	— 29	11
—29 *gh.*	—0·49	—18		
	12·17	844		

	Tithi.	☾'s an.	gh.	p.
4000 K. Y.	8·98	523	— 16	40
1 Bhâdr.	5·26	464	+ 15	41
	14·24	421	— 0	59
—1 *gh.*	—0·02	1		
	14·22	420		

Now it is evident that, as 12·17 + 17·83 = 30, and 14·22 + 15·78 = 30, those years in Table II whose *tithi* is larger than 15·78, but smaller than 17·83, may have had an intercalary Śrâvaṇa; for such a *tithi* added to that for the beginning of Śrâvaṇa of 4000 K. Y., *viz.* 12·17, will give less than 30, indicating wane of the moon, and added to the *tithi* for the beginning of Bhâdrapada, *viz.* 14·22, give more than 30 or indicate waxing moon as required for an intercalary month. Running the eye over Table II, we select the years whose *tithi* is between 15·78 and 17·83, *viz.* 7, 15, 34, 53, 64, 72, 91.

In these years, therefore, an intercalation of Śrâvaṇa was possible. Those years whose *tithi* is very near the limits must be calculated, as for them the intercalation is doubtful, *e.g.* 7, the *Cor.* of 7 being —12 *gh.* 21*p.* subtract the equivalent (Table IV) from the result.

	Tithi.	An.
K.Y. 4000	12·17	844
7	17·65	798
4007	29·82	642
—12 *gh.*	—0·20	—7
	29·62	635
an. 635	+0·11	
	29·73	

As 29·73 indicates waning moon, the month was intercalary, for without calculation we see that the 1st *tithi* of Bhâdrapada comes out larger than 30 or 0.

But, if we compute for 4064, we find that the new-moon had occurred before the beginning of the Śrâvaṇa,—there being consequently no intercalary month of that name.[16]

34. As the beginning of the solar year, and consequently of the solar months, depends on the length of the solar year, and as the different authorities vary in this particular, Table I exhibits columns for the solar correction according to the different *Siddhântas* most in use. By using the different columns we get different beginnings of the solar months. Usually the difference amounts to a few *ghaṭikâs* only; but the *Brahmasiddhânta* yields a date differing by about one day from that of the others.

It is obvious that the difference in the beginning of the solar months, even if it amounts to few *ghaṭikâs* only, may occasionally make one month intercalary according to one *Siddhânta*, while others would make a preceding or following month intercalary. For instance, if we calculate Bhâdrapada in Saṁvat 1467, that month is an ordinary one according to the *Ârya Siddhânta*, but intercalary according to the *Sûrya Siddhânta*. while Âśvina is intercalary according to the *Ârya Siddhânta*.

1st.—The calculation according to the *Sûrya Siddhânta*—

	Tithi.	An.	gh.	p.
4500	20·99	428	+ 9	15
11 years	1·87	820	— 9	16
4511 K. Y.	22·86	248	— 0	1
Bhâdra.	5·26	464	+ 17	57
	28·12	712	+17	56
18 *gh.*	+0·30	11		
	28·42	723		
an. 723, eq. =	0·01			
	28·43, Moon waning.			

	Tithi.	An.	gh.	p.
4511 K. Y.	22·86	248	— 0	1
Âśvina	6·80	589	+ 19	30
	29·66	837	+ 19	30
19 *gh.*	+0·32	11		
	29·98	848		
an. 848, eq. =	0·08			
	0·06, Moon waxing.			

[1] The two factors which influence the preliminary result are *Cor.* of the year and ☾'s *an.* The former may even extend the limits under certain circumstances: if *Cor.* of the odd year is —, the limit for the beginning of the month may become extended, if +, that for the end of the month; but never by more than 0·60.

Now compute Âśvina and Kârttika according to the *Ârya Siddhânta.*

	tithi.	An.	gh.	p.
4500 K.Y.	20·99	428	+3	45
11 years	1·87	820	—9	16
4511 K. Y.	22·86	248	—5	31
Âśvina	6·80	589	+17	51
	29·66	837	+12	20
+12 gh. =	0·20	7		
	29·86	844		
An. 844, eq. =	0·08			
	29·94 Moon waning.			

	tithi.	An.	gh.	p.
4511 K. Y.	22·86	248	— 5	31
Kârttika	8·29	714	—14	47
	1·15	962	—19	18
—19 gh. =	—32	—11		
	0·83	951		
951, eq. =	0·28			
	1·11 Moon waxing.			

The calculation proves that in Saṁvat 1467, Bhâdrapada was intercalary according to the *Sûrya Siddhânta*, and Âśvina according to the *Ârya Siddhânta.* However, to decide such cases beyond doubt, the *tithi* should be calculated by means of the Special Tables for the *Siddhânta* in question.

35. *On mean intercalations.* [17]—It is probable that, in ancient times, besides the system of true intercalations as described above, that of mean intercalations was used. The difference between the systems consists in this, that in the latter *mean* solar and lunar months are used instead of *true* ones. As a mean lunar month is shorter by 54 *ghaṭikâs* 28 *palas* than a mean solar month, it follows that a mean intercalation is due whenever mean new-moon occurs within 54*gh.* 28*p.* after the beginning of the mean solar month, or, expressed in a form more convenient for calculation,—when at the beginning of the mean solar month the mean *tithi* is between 29·08 and 30·00. From this, it follows that, when at the beginning of a mean solar month the mean *tithi* is found to be between 0·00 and 0·92, the *preceding* month was intercalary.

Mean solar month.	Mean tithi.
(Chait. prec. yr. . .	29·68)
Vaiśâkha . . .	0·60
Jyaishṭha . . .	1·52
Âshâḍha . . .	2·44
Śrâvaṇa . .	3·37
Bhâdrapada . .	4·29
Âśvina . . .	5·21
Kârttika . . .	6·13
Mârgaśira . . .	7·06
Pausha . . .	7·98
Mâgha . . .	8·90
Phâlguna . . .	9·82
Chaitra . . .	10·74
(Vaiś. fol. yr. . .	11·67)

In computing mean intercalations we sum up the *tithi* and *Cor.* for the century and the odd years, from Tables I and II, and add the mean *tithi* current at the beginning of the mean solar month under consideration from the table here given.

Ex. 1.—The Khera plate of Dharasena IV mentions an intercalary Mârgaśira. It has been proposed by Dr. Schram[18] that this was a mean intercalation which occurred in 3749 K.Y. Let us calculate the mean *tithi* for the beginning of mean Mârgaśira according to the above rules.

	tithi.	gh.	p.
Table I. 3700 K. Y.	19·17	+ 7	5
„ II. 49 years	2·50	—19	29
mean Mârg.	7·06		
	28·73	—12	24
„ IV.—12 *gh.*	—0·20		
	28·53		

[17] The calculation of mean intercalations is easier by the Special Tables, as will be seen from the example in § 56.

Sitzungsberichte der phil. hist. Classe der Kais. Akademie der Wissenschaften, Wien 1885.

As the *tithi*, 28·53, does not come within the limits prescribed above for a mean intercalation (*viz.* 29·08—30), Mârgaśira could not have been intercalary.

Now, as a mean solar month is longer by 54*gh.* 28*p.* than a mean lunar month, it follows that at the beginning of a mean solar month the *tithi* will be larger by 0·92 than at the beginning of the preceding one. By this rule we find that in this case the mean *tithi* at the beginning of mean solar Pausha (the month after Mârgaśira) was 28·53+0·92=29·45. And as this *tithi* makes the month intercalary, it follows that there was a mean intercalation of Pausha; if, however, we have recourse to Brahmagupta's way of naming intercalary months (see § 10, note 7), the intercalated month was Mârgaśira.[19]

Ex. 2.—It has been suggested[20] that, in Kaliyuga 3741, mean Pausha was intercalary according to the elements of the *Brahma Siddhânta.*

	tithi.	gh.	p.
3700 K. Y.	19·17	+13	7
41 years	3·04	+36	21
m. Pausha	7·98	—60	
	0·19	—10	32
11 *gh.* —	0·19		
	0·00		

The *tithi* being just within the prescribed limits, the month was probably intercalary. See below § 57.

On Karaṇas.

36. Half a *tithi* is called a *Karaṇa*, sixty of which make up a lunar month. Their names and numbers are as follows:—

Kiṁstughna	. 1
Bava .	. 2, 9, 16, 23, 30, 37, 44, 51
Bâlava .	. 3, 10, 17, 24, 31, 38, 45, 52
Kaulava .	. 4, 11, 18, 25, 32, 39, 46, 53
Taitila .	. 5, 12, 19, 26, 33, 40, 47, 54
Gara .	. 6, 13, 20, 27, 34, 41, 48, 55
Baṇij	. 7, 14 21, 28, 35, 42, 49, 56
Vishṭi	. 8, 15, 22, 29, 36, 43, 50, 57
Śakuni	. 58
Nâga	. 59
Chatushpada	60

The first *tithi* of the bright fortnight is composed of the *karaṇas* Kiṁstughna and Bava, the second of Bâlava and Kaulava, and so on. The *karaṇas* therefore do not denote a particular day, but a certain part of a day, about 29½ *ghaṭikâs.*

Ex.—In the date Saṁ. 1275 (*i.e.* 4319 K.Y.) Mârgaśira-sudi 5, the *karaṇa* Bâlava is given. What time of the day is intended? We calculate first the *tithi.*

4300 K. Y.	27·78	251
19 years	0·32	864
4319 K. Y.	28·10	115
28 Mârgaśira	6·09	783
	4·19	898
An. 898, eq. =	0·17	
	4·36	

Ind. ●	=	1·90
Ind. *sudi* 5	=	6·90

From the above scheme of *Karaṇas* we make out Bâlava No. 10 to have been the second half of *sudi* 5. By table IV we find that the difference between the *tithi* for the beginning of the day 4·36 and that for the beginning of Bâlava 4·50, *viz.* 0·14, is equal to about 8 *ghaṭikâs.* The time intended by Bâlava therefore was 28th Mârgaśira 8 to 37 *gh.*

[19] Comp. also Fleet, *Corp. Insc. Ind.* vol. III, introd. p. 94.
[20] *Sitzungsberichte*, ut sup.

Place of the Moon.

37. *Moon's Nakshatra and Râśi.*—Dates are frequently coupled with the name of the *Nakshatra* or asterism in which the moon was at the time of the date; occasionally the *râśi* or zodiacal sign also is mentioned. Table IX shows which part of the Hindu ecliptic is attributed to each *Nakshatra*, and Table V that of the single zodiacal signs, *e. g.* Table IX shows that the *Nakshatra* Viśâkhâ denotes 200°—213° 20′ of sidereal longitude,[21] and Table V that the sign Kumbha extends from 300° to 330° sidereal longitude. If we know the longitude of the moon, we can tell at once in which *Nakshatra* and zodiacal sign she stood. It will, therefore, be necessary to calculate the moon's longitude. Now the longitude of the moon=longitude of the sun + distance of sun and moon. The latter element is furnished by the *tithi;* for, as one *tithi* is equal to the time required by sun and moon to increase their distance by 12°, we need only multiply the *tithi* for a given moment by 12, to find the distance of the sun and moon in degrees. We found above that, at the beginning of the 28th Mârgaśira 4319 K.Y. the true *tithi* was 4·36; it follows that the distance of sun and moon is $12 \times 4{\cdot}36 = 52°{\cdot}32$ or 52° 19.′

The true longitude of the sun for the beginning of every day of the solar year is furnished by the column headed ☉'s longitude in Table VIII, but a correction must be applied for the interval between the beginning of the mean solar year and the beginning of the given day.

Rule.—Having found 'Cor.' for the year under consideration, add as many minutes to the longitude of the sun as 'Cor.' contains *ghaṭikâs*, if 'Cor.' is negative; if positive, subtract the amount from the sun's longitude.

Thus for the 28th Mârgaśira 4319 K.Y. we must subtract 14′, for 'Cor.' (+19 *gh.* 35*p.*—5 *gh.* 6*p.*) = +14 *gh.* 29*p.* from the longitude of the sun given in Table VIII for the day under consideration, *viz.* 237° 49′. The result, 237° 35′, is the sun's longitude at the beginning of 28th Mârgaśira 4319 K. Y.

To the longitude of the sun must be added the distance of sun and moon; the result, retrenching 360° if necessary, will be the true longitude of the moon. Turning with the longitude of the moon to Table IX, we find in which *Nakshatra* the moon was at the moment calculated. In the same way Table V shows through which zodiacal sign she was then passing through.

In this example we have—

Longitude of the sun	237°	35′
+ Distance of sun and moon	52°	19′
Longitude of the moon	289°	54′

According to Table IX the moon stood in Śravaṇa (280°—293° 20′), and would pass into the next *Nakshatra* in between 15 and 16 *ghaṭikâs*, the difference 293° 20′—289° 53′=3° 27′, being equal to 15*gh.* 43*p.* (the motion of the moon being supposed to be of mean amount), see Table XI. Table V shows the moon to have been in *Makara*, the Hindu Capricornus.

Yogas.

38. A *Yoga* is the period, of variable length, in which the joint motion in longitude of the sun and the moon amounts to 13° 20′, being the extent of a lunar mansion. There

[21] The Hindus use sidereal, not tropical, longitude.

are therefore as many *Yogas* as there are lunar mansions, *viz.* 27. Their names and the portions of each are given in Table IX, together with those of the *Nakshatras.*

In order to find the *Yoga* current at a given moment, add the longitudes of the sun and moon, and interpret the sum from Table IX.

Ex.—For the beginning of the day, whose *Nakshatra* we have calculated above, 4319 K.Y. Mârgaśira-sudi 5, we have found :—

Longitude of the sun	237° 35′
Longitude of the moon	289° 54′
Accordingly degrees of *yoga*	527° 29′ or 167° 29°

Table IX shows that 167° 29′ falls within the portion of the *yoga* Vyatîpâta (160° —173° 20′) which therefore was current at the beginning of the day. It ended, and Harshaṇa commenced, after about 25 *ghaṭikâs*, as the difference 5° 53′ (=173° 20′—167° 29′) is by Table XI =24 *gh.* 55 *p.*

I shall now give the calculation of a date which contains all the particulars discussed in the foregoing paragraphs.

Vikrama 1531 (K.Y. 4575), Kârttika-sudi 9, Budhavâsare, Dhanishṭhâ-nakshatre Vṛiddhi-yoge, Kaulava karaṇe, Kumbha-râśi-sthite chandre.

Calculate first the *tithi* and weekday—

	Fer.	Tithi.	An.	gh. p.
4500 K.Y.	(0)	20·99	428	+ 3 49
75 years	(3)	19·45	173	+ 20 4
4575 K.Y.	(3)	10·44	601	+ 23 53
20th Kârttika	(1)	27·57	403	
	(4)	8·01	4	
An. 4, eq.		0·43		
		8·44		

Ind. ● = 19·56
Ind. *sudi* 9= 28·56

Accordingly, on Wednesday (4), at mean sunrise, the 9th *tithi* was current; it ended about 33 *ghaṭikâs* (the equivalent of 0·56, see Table IV) later. At the same moment ended the *karaṇa* Kaulava, No. 18, being the second-half of the ninth *tithi.*

On the 20th Kârttika the longitude of the sun is 199° 15′ (Table VIII), *Cor.* for 4575 K.Y. is, as calculated above, + 23*gh.* 53*p.* Accordingly 23′ 53″, or say 24′ must be subtracted from the ☉'s longitude. The remainder 198° 51′ is the true longitude of the sun at the beginning of the day under consideration.

The distance of sun and moon is 12×8·44=101°·28 or 101° 17′. Add longitude ☉ to find the ☾'s longitude=198° 51′+101° 17′=300° 8′. Table IX shows that the moon stands in the *Nakshatra* Dhanishṭhâ, and Table V that she had just entered Kumbha or Aquarius, when her longitude is 300° 8′.

The *yoga* is 198° 5′ + 300° 8′=498° 59′ or 138° 59′, and Table IX shows that the *yoga* Vṛiddhi was current.

This proves the date to be correct in all particulars. By the rules laid down in § 20 we find that the day corresponded to the 19th October 1474, (Old Style), a Wednesday.

The place of the Sun.

39. To find for any particular day the sun's place in the ecliptic—either in zodiacal sign or in lunar mansion, we need only use the sun's longitude for the given day (in Table VIII) for the Index of Tables V and IX, and in the same way as we have used the

longitude of the moon for finding the *Nakshatra* and *Râśi*. The *Nakshatras* divide the course of the sun into 27 equal parts which determine fixed periods of the year. These periods are commonly used for regulating agricultural labours; but I do not know whether they are mentioned in the dates of documents. The particulars most frequently mentioned in dates are the *Saṁkrântis*. As a *Saṁkrânti* is the moment of the true beginning of a solar month, this element can be derived from the tables.

In connection with those *Saṁkrântis*, however, which determine the Uttarâyaṇa and Dakshiṇâyana, it will be necessary to remark respecting the precession of the equinoxes (*Krântipâtagati*), that as stated above, the Hindus measured all longitudes on the fixed ecliptic, taking for its initial point the vernal equinox, as it was in 3600 K.Y.[22] At that time the sidereal (*nirayana*) signs coincided with the tropical (*sâyana*) signs, but afterwards they differed from each other by the amount of the precession (*ayanâṁśa*). This amount, in degrees, is found by multiplying the difference between the given year K.Y. and 3600[23] by 3, and dividing by 200; *e.g.* in 4572 K.Y. the *ayanâṁśa* amounted to $\frac{3\times 972}{200}=14^{\circ}\cdot 58$ or $14^{\circ}\ 34'\cdot 8$. By so much the beginning of every tropical (*sâyana*) sign precedes that of the sidereal sign. Hence to find a tropical (*sâyana*) Saṁkrânti, we must subtract the *ayanâṁśa* of the given year from the number of degrees supplied by Table V for the beginning of the fixed (sidereal or *nirayana*) signs. Thus the beginning of the tropical sign Kanyâ in K.Y. 4572 will be at $150^{\circ}-14^{\circ}\ 35'=135^{\circ}\ 25'$ of longitude. Table VIII shews that the sun was at that point about the 17th Bhâdrapada. By means of Tables I-III, we find the day to have been a Friday, Bhâdrapada *sudi* 2, and we compute as follows:—

	Fer.	Tithi.	☾'s An.	Cor. gh.	h.
K.Y. 4500	(0)	22·99	428	+ 3	45
72 years	(0)	17·04	434	—22	30
17th Bhâdr.	(6)	21·54	45	—18	45
	(6)	1·57	907		
	An. 907, eq.	0·19			
		1·76	Friday, *sudi* 2		

We must, however, as explained above, § 37, add as many minutes to the longitude of the sun for the calculated day (in this case, $135^{\circ}\ 10'$) as the solar correction for the year ($-18gh.\ 45p.$) has *ghaṭikâs*; $135^{\circ}\ 10' + 19' = 135^{\circ}\ 29'$. Accordingly the *sâyana Saṁkrânti* of Kanyâ, which should take place at $135^{\circ}\ 25'$, occurred just before the beginning of the day calculated, *viz.* about 4 *ghaṭikâs* earlier.

A calculation of this sort should be made whenever a date coupled with a *Saṁkrânti*, does not come out correctly in all particulars. For, it is possible that a *sâyana* Saṁkrânti may be intended, since these Saṁkrântis too are auspicious moments.

Eclipses.

40. The solar and lunar eclipses from B.C. 1207 down to A.D. 2000 are registered in von Oppolzer's *Canon der Finsternisse*.[24] The details of solar eclipses can easily be derived from the tables of Dr. Schram (*ib.* vol. LI). To these works therefore the student is referred in all cases where actual eclipses have to be dealt with. But the

22 According to the *Siddhânta Śiromaṇi*, however, in 3628 K.Y.

23 The rule for the *Siddhânta Śiromaṇi* is—subtract 3628 from the given year K.Y.; the remainder is the *ayanâṁśa* in minutes. Subtract from this result, if a high degree of accuracy is wanted, the tenth part of the above remainder taken as seconds.

24 *Denkschriften der Kaiserlichen Akademie der Wissenschaften, math. natur. Classe, Wien*, vol. LII.

eclipses mentioned in inscriptions are not always actually observed eclipses, but calculated ones. My reasons for this opinion are the following:—Firstly, eclipses are auspicious moments, when donations, such as are usually recorded in inscriptions, are particularly meritorious. They were therefore probably selected for such occasions, and must accordingly have been calculated beforehand. No doubt they were entered in the *pañchâṅgas* or almanacs in former times as they are now.[25] Secondly, even larger eclipses of the sun, up to seven digits, pass unobserved by common people, and smaller ones are only visible under favourable circumstances. Thirdly, the Hindus place implicit trust in their Śâstras, and would not think it necessary to test their calculations by actual observation. The writers of inscriptions would therefore mention an eclipse if they found one predicted in their almanacs.

For determining the occurrence of eclipses the columns showing the sun's distance from the moon's nodes in Tables VI, VII, VIII, serve. The quantities are given in thousandth parts of the semicircle. In Table VI this quantity is given from modern European tables and also according to the *Ârya*, *Sûrya*, and *Brahma Siddhântas*, and the *Siddhânta Śiromaṇi*.[26] In the remaining tables the difference between the various authorities is so small that it is neglected.

According to Hindu science—

At new-moon a solar eclipse is	certain, if ⊙ from node is between	0	and	90,	or 910	and	1000
	doubtful " " "	91	"	105	" 909	"	895.
	impossible " " "	106	"	894			
At full-moon a lunar eclipse is	certain, if ⊙ from node is between	0	and	58,	or 942	and	1000
	doubtful " " "	59	"	75	" 911	"	923
	impossible " " "	76	"	922			

41. A solar eclipse can only happen at the time of new-moon, *i.e.* when *tithi* is 0 or 30, and a lunar eclipse only at the time of full-moon, *i.e.* when the *tithi* is 15·00. It is also obvious that an eclipse of the moon is visible only when the moon is above the horizon during the eclipse, *i.e.* after sunset; and a solar eclipse is invisible after sunset. Therefore, in computing lunar eclipses, we calculate the moment of mean sunset, *i.e.* 30*gh.* For this we must add 0·51 to the *tithi*, 18 to anomaly, 3 to node as shown below:—

Ex.— Śaka 851, 4030 K.Y. Mâgha-sudi 15, Sunday, a lunar eclipse.

According to Tables I-III, and (node) Tables VI—VIII:—

	Fer.	Tithi.	☾'s An.	Node.	
4000 K. Y. . . .	(1)	8·98	523	62	Ind. ● 18·83
30 years . . .	(3)	2·19	684	228	Ind. *Tithi* 3·83
4030 K. Y. . . .	(4)	11·17	207	290	
27 Mâgha . . .	(4)	2·81	815	712	
30 *ghaṭikâs* . . .		0·51	18	3	
. .	(1)	14 95	40	5	
☾'s an. 40, eq. . .		52			
	Tithi	15·01			

[25] An eclipse which was not visible in India is recorded in Professor Kielhorn's paper, "Examination of questions connected with the Vikrama era."—*Ind. Ant.* vol. XIX, p. 116, eclipse No. 83.

[26] The limits of a solar eclipse are approximate only. They determine eclipses that might be visible at some point of the whole earth. The Hindu method of calculating solar eclipses is cumbrous, and the results cannot be given in a convenient tabular form. It is different with lunar eclipses. In the middle of solar Âshâḍha a lunar eclipse occurs, as calculated by the *Sûrya Siddhânta*, when at full-moon the anomaly is 500 and 0 and distance from node 75 or 925, or anomaly 0 and distance of node 62 or 938; in the middle of solar Pausha, when at full-moon the anomaly is 500 and distance from node 74 or 926, or anomaly 0 and distance from node 58 or 942. It will be seen that the limit is influenced more by the value of the anomaly than by the time of the year. Details need not be entered upon here; these remarks will serve for most cases.

The *tithi* 15·01, shows that on the day calculated, a Sunday, full-moon occurred before mean sunset at Laṅkâ (about ½*gh.* earlier, see Table IV) and as 'node'=5 is within the limits of certain eclipse, there was therefore a lunar eclipse visible in India. The date is 17th January, 930 A.D. On that day, according to von Oppolzer's *Canon*, the middle of a lunar eclipse occurred at 13 hours 8 minutes after mean midnight at Greenwich[27] or 12 hours 12 minutes after mean sunrise at Laṅkâ. Our tables make the middle of the eclipse fall about half an hour earlier than the true time.

Ex.—Was there a solar eclipse in 4730 K.Y. Jyaishṭha?

Calculate first Jyaishṭha badi 15[28]:—

	Tithi.	An.	Node.	
4700 K. Y.	14·20	605	345	Ind. ● 13·61
30 years	2·19	684	328	
4730 K.Y.	16·39	289	573	
13 Âshâḍha	13·30	631	413	
	29·69	920	986	
An. 920, eq.	0·22			
	29·91			

New-moon therefore occurred 0·09 *tithis* or 5½ *ghaṭikâs* = 2 hours 12 minutes later. There was a solar eclipse at that time, though we do not find by the tables whether it was visible in India or not. But we learn from von Oppolzer's *Canon* and maps that the eclipse on the 11th June 1629 was so. The middle of the eclipse occurred at 3 hours after mean sunrise at Laṅkâ. Our result therefore is in error by 48 minutes.

The cycles of Jupiter.

42. A chronological datum not unfrequently met with in Hindu dates is the name of the year according to one of the cycles of Jupiter. We know of two Jovian cycles, one of twelve years, and one of sixty years; and there are two ways of applying either cycle. We begin with:

43. *The sixty-year cycle.*—The names of the 60 years in the cycle are given in Table XXIII. They are applied, in the north, on strictly astronomical principles, while in the south this cycle has no longer any connection with the movements of Jupiter. The years in the sixty-year cycle in the south coincide with the civil (solar) year.

Rule.—Subtract 14 from the year of the Kaliyuga, or 15 from the Śaka year, or 30 from the Vikrama year (or 33 from the year A.D.); divide by 60, and the remainder is to be looked out in Table XXIII as the number of the cyclic year; *e.g.*—For 3678 K.Y. 3678—14=3664. $\frac{3664}{60}$ = 61, rem. 4. No. 4 in Table XXIII is Hemalamba, which therefore is the cyclic name of the K.Y. year 3678; that year is Śaka 499, Vikrama 634, 577 A.D.; and going through the same operation as prescribed in the rule with these numbers, we always arrive at the same result.

44. *The sixty-year cycle in the north.*—The years in this cycle are Jovian years. The Jovian year is equal to the mean time (about 361 days 1½ gh.), required by Jupiter to move through a zodiacal sign. Therefore one cycle contains five mean revolutions of Jupiter[29] or about 59⅓ civil years.

[27] Greenwich time from midnight, less 56 minutes, gives mean Laṅkâ time from sunrise.

[28] Compare note 9.

[29] These five minor cycles, contained in one whole cycle, are named (after the five years of the Vedic *yuga*):—(1) Saṁvatsara, (2) Parivatsara (3) Idavatsara, (4) Anuvatsara, and (5) Udvatsara.—*Bṛihat Saṁhitâ*, VIII, 24.

The columns headed 'Jupiter's Samvat.' in Tables VI, VII, VIII, furnish the means of ascertaining the Jovian year for any given epoch. The numbers in them must be summed up for the parts into which the given date is divided, *e.g.*, we find for 3542 K.Y., 18th Kârttika :—

	Jup. Sam.
3500 K.Y.	0·95
42 years	42·4914
18th Kârtt.	0·5595
	44·0009

The integers give the number of the current cyclic year, Table XXIII; in this case 44=Îśvara[30]; the decimals show how much of the Jovian year has elapsed, here $\frac{9}{10,000}$ or about 20 *ghaṭikâs*. This result however does not refer to the beginning of the day, but to a point of time removed from it by the same interval as separates the beginning of the mean solar year from the beginning of the day. We find the moment in question by the 'Cor.' of the given year; in this case for 3542 K. Y. the 'Cor.' is (according to the *Sûrya Siddhânta*) + 32 *gh.* 52 *p.*—8 *gh.* 8 *p.* = + 24 *gh.* 44 *p.* Therefore the result above refers to 24 *gh.* 44 *p.* after mean sunrise at Lankâ, and the beginning of the year Îśvara occurred about 4 *gh.* after mean sunrise of the 18th Kârttika in K.Y. 3542.

The tables yield the Jovian years according to the *Sûrya Siddhânta* with *bîja*. To find the same according to the *Sûrya Siddhânta* without *bîja*, multiply the year of the Kaliyuga by 2, and divide by 9; the quotient is to be added as 10,000th parts to the value given in the tables. In the present instance $3542 \times \frac{2}{9} = 787$. Dividing by 10,000 gives 0·0787, and this added to 44·0009 makes 44·0796,—the value according to the *Sûrya Siddhânta* without *bîja*.

For the *Ârya Siddhânta*, divide the year K.Y. by 3, and add the quotient divided by 10,000 to the tabular value. In the example this gives 44·1190.

For the *Brahma Siddhânta*, multiply the year K.Y. by 0·0000401528; add to the tabular value and subtract 0·0180.

For *Śiddhânta Śiromaṇi*, multiply the year K.Y. by 0·0000273639; add to tabular value and subtract 0·0180.

For the *Ârya Siddhânta* with Lalla's correction subtract 420 from the Śaka year (or 3599 from the year of the Kaliyuga); multiply the remainder in 0·00010445; and subtract the product from the 'Jupiter's Sam.' as found for the original *Ârya Siddhânta*.

The tables yield the result correctly within about 2 *ghaṭikâs*, which in most cases is an accuracy not needed. If, however, for special cases, still greater accuracy should be required, it can be found with a high degree of exactness for the commencement of the solar year, by the help of the above rules, for the various *Siddhântas*. But it must be calculated for the day of the year by multiplying the *ahargaṇa*, or number of the day of the year, by 0·00276988 for *Sûrya Siddh.*; by 0·00276982 for the same *Siddhânta* with *bîja*; by 0·00276991 for the *Ârya Siddhânta* :—the product is the 'Jupiter Sam.' for the beginning of the day under consideration. The fractions here given are the increase of the element in one solar day (60 *ghaṭikâs* or 24 hours). From these data the increase for any interval in *ghaṭikâs* or hours can easily be found.

[30] If they are larger than 60, subtract 60. The value of 'Jupiter' in Tables VI and VII, it must be noted, refer to the beginning of the *mean* solar year.

Ex.—To find the cyclic year current at the beginning of 4210 K. Y., and on what day that year ended. From Tables VI and VII, and Tables I and II, we have—

	Jup.	Cor. *Sûrya Siddh.*	Cor. *Ârya S.*
4200 K. Y.	49·14	− 28 *gh.* 22 *p.*	− 32 *gh.* 30 *p.*
10 years	10·117	+ 35 „ 12 „	+ 35 „ 12 „
4210 K. Y. . . .	59·257	+ 6 *gh.* 50 *p.*	+ 2 *gh.* 42 *p.*

Jup. 59·257 shows that Nandana, the 60th or last year of the cycle, was current The fraction shows how much of it had elapsed according to the *Sûrya Siddhânta* with *bîja*. The amount according to the same *Siddhânta* without *bîja* must be raised by $\frac{2}{9}$ of 4210 ÷ 10000 = 0·09355 and is 59·3506. For the *Ârya Siddhânta*, we must add 4210 ÷ 30000 = 0·1403 and obtain J.=59·3973.

Consequently, the end of the year Nandana, or the beginning of Vijaya, occurred after the beginning of the solar year 4210 K.Y.,—by the *Sûrya Siddhânta* with *bîja* after 0·743; by the *Sûrya Siddhânta* without *bîja* after 0·6494; and by the *Ârya Siddhânta* after 0·6027. Now taking these figures as arguments in Table VIII, we find the days on which the Jovian year ended according to the three authorities, *viz.* by:—

(*a*) *Sûrya Siddhânta* with *bîja* on 25 Pausha, when J.=0·7424, diff. 0·0006;
(*b*) *Sûrya Siddhânta* without *bîja* on 20th Mârgaśira, J. = 0·6482, diff. 0·0012;
(*c*) *Ârya Siddhânta* on 3rd Mârgaśira, J.=0·6011, diff. 0·0017.

Multiplying the figures of the differences by $2\frac{1}{6}$, the result is the difference in *ghaṭikâs*. In this case we have (*a*) 13 *gh.*, (*b*) 26 *gh.*, (*c*) 37 *gh.* Added to *Cor.* we get (*a*) 20 *gh.*, (*b*) 33 *gh.*, and (*c*) 40 *gh.* for the times after mean sunrise at Laṅkâ, of the above calculated days, when the year Nandana ended according to the three different authorities.

It must, however, be noted that this calculation yields results correct only within two *ghaṭikâs*, unless the calculation explained above should be resorted to, in which case any degree of accuracy may be attained.

45. The beginning of a cyclic year according to the *Ârya Siddhânta* falls about three days earlier than if the same moment is calculated by the rule of Varâha Mihira (*Bṛihat Saṁhitâ*, VIII, 20, 21) or the *Jyotistattva*. To find the time intervening between the beginning of the mean solar year and the beginning of the cyclic year according to these authorities we compute thus: Multiply the Śaka year by 44, add to the product 8589, according to Varâha Mihira, or 8582 according to *Jyotistattva;* neglect the quotient, and multiply the remainder by 365 days 15 *ghaṭikâs* 31 *vinâḍîs*,[31] the product divided by 3750 shows the interval in days supposed to have elapsed since the beginning of the cyclic year, current at the beginning of the solar year, up to the latter moment. If it is proposed to find the end of Jupiter's year current at the beginning of a given Śaka year, we must compute, not for the given year, but for the next following one, and find the part of the Jovian year elapsed up to the calculated moment. The result subtracted from 365 days $15\frac{1}{2}$ *ghaṭikâs* shows the interval elapsed from the beginning of the given Śaka year up to the end of the Jovian year which was current at its

[31] This part of the rule, which is wanting in Varâha Mihira, is absurd. The remainder should be multiplied by 361 days 1 *gh.* 21 *p.* The *Kshepa* too does not correspond with the results of the *Ârya Siddhânta*, on which the rule is based; it ought to be 8626 instead of 8589 or 8582.

beginning.[32] If a few days do not influence the general result, as is usual, the tables here given may be used, applying the correction prescribed for the *Ârya Siddhânta*.

46. *The cycle of twelve years.*—The years in this cycle take the names of the common months with *Mahâ* prefixed, *e.g.* Mahâkârttika; they are entirely regulated by Jupiter, but on two distinct principles.

47. *The mean-sign system.*—In this system the name of the Jovian year depends on the zodiacal sign in which mean Jupiter is at a given time. The end and beginning of the Jovian years are exactly the same as in the sixty-year cycle. We can therefore use the tables as before.

Rule.—Find 'Jupiter's Saṁvat.' for the given date according to the *Siddhânta* to be employed. Divide the figures of the integral part by 12, neglect the quotient, and the remainder is the index of the subjoined table:—

0 or 12. Âśvayuja.	4. Mâgha.	8. Jyaishṭha.
1. Kârttika.	5. Phâlguna.	9. Âshâḍha.
2. Mârgaśira.	6 Chaitra.	10. Śrâvaṇa.
3. Pausha.	7. Vaiśâkha.	11. Bhâdrapada.

E. g. we have found above that 'Jupiter' according to the *Ârya Siddhânta* about the beginning of 4210 K.Y. was 59·3973. By the above rule we find that then the year Mahâ-Bhâdrapada was running, which ended, as calculated above, on the 3rd Mârgaśira.

48. *The heliacal rising system.*—The year in this system begins with the heliacal rising of Jupiter *i.e.* his reappearing after his conjunction with the sun: the year is named from the *Nakshatra* in which the planet rises heliacally, in the same way as the lunar months were named after the *Nakshatra* in which the moon of a particular month became full. The 27 (or 28) *Nakshatras* are formed into twelve groups (indicated in Table IX by an asterisk placed after the last *Nakshatra* in each group). Of the two or three nakshatras in each group, only one (the name of which is spaced in Table IX) gives name to the lunar month or to the Jovian year.

The problem, therefore, is to find the apparent longitude of Jupiter at his heliacal rising, and the time of the rising. If we know the longitude of Jupiter when heliacally rising, we can readily interpret it according to the different systems of the *Nakshatras* as specialised in Tables IX and X. A strict solution of the problem would entail long and troublesome calculations. As, however, all dates as yet found in this cycle have already been calculated (by Mr. Dîkshit, *Corpus Inscrip. Ind.* vol. III, p. 105), there will only be occasion to solve the problem when new dates occur. We may therefore be content to ascertain the time of Jupiter's heliacal rising within a day from the correct date, and the longitude of Jupiter at that time within a degree of the truth.

Ex.—Calculate 'Jupiter's Sam.' for the beginning of the year; *e.g.* 3576 K. Y., 0·95 + 16·8892 = 17·8392. For the *Sûrya Siddhânta* without *bîja* add $\frac{2 \times 3576}{90000}$ = 0·0795, making 17·9187, or rejecting the 3rd and 4th decimals—17·92. Subtract 12 or multiples of 12 from the integers, and there results 5·92. Multiply this by 0·083, add the product, 0·49, to the 'Jupiter Sam.' found above: 5·92 + 0·49 = 6·41. With the sum apply to Table XII and add to or subtract from it (as directed in the table) the

[32] For such problems, however, Professor Kielhorn's tables published in the *Indian Antiquary* (1889), vol. XVIII, pp. 193ff. and 380ff., and in the *Abhandlungen der Königl. Gesellschaft der Wissenschaften zu Göttingen*, 1889, supply an easy method of computation.

equation; thus 6·41 — 0·05 = 6·36. Convert the last result into degrees by multiplying it by 30; 6·36 × 30 = 190°·8 or 190°48′. This is approximately the longitude of Jupiter at his conjunction with the sun. Add 1°; the result will be approximately the apparent longitude of Jupiter at his heliacal rising. Looking out this longitude of Jupiter in Tables IX and X, we find in which *Nakshatra* the planet stood, and consequently what was the name of the Jovian year which then commenced. In this case we find Mahâ-Vaiśâkha according to the *Brahma Siddhânta*, and Mahâ-Chaitra according to the other systems. But this is only an approximation.

49. The second part of the problem is to find the date of the heliacal rising of Jupiter. At the same time we can correct the longitude of Jupiter. Select in Table VIII the day on which the longitude of the sun is equal to that found for Jupiter at his conjunction, and calculate 'Jupiter Sam.' for that day, correct it by the equation, and convert it into degrees as above. The longitude of the sun is 191° 14′ on the 12th Kârttika; 'Jupiter' for that day is 0·5429, which added to the value for beginning of 3576 K.Y.: 5·9187 makes 6·4616 or 6·46; subtract equation 0·05, and we have 6·41, or in degrees 192°·3 or 192° 18′. If the resulting longitude of Jupiter is smaller than the longitude of the sun calculated for the day, the conjunction has passed; if larger, it is still to come. In either case the conjunction is removed from the computed date by as many days as degrees intervene between Jupiter and the sun. About 14 days after the conjunction the heliacal rising of Jupiter takes place, and the new Jovian year begins. In this case we find that the conjunction took place on the 13th Kârttika, and consequently the heliacal rising of Jupiter about the 27th, when his longitude was about 193° 18′. The 27th Kârttika of 3576 K.Y. is to be calculated by Tables I—III,—

	Fer.	Tithi.	An.	
3500 . . .	(1)	25·96	585	
76 years . .	(5)	1·27	456	
27 Kârtt. . .	(1)	4·67	658	
	(7)	1·90	699	
An. 699, eq.		= 0·02		
		1·92		Kârttika-sudi 2, Saturday.

Mr. Dîkshita, who has calculated the same date, ascertained that the heliacal rising took place on Kârttika-sudi 1; this result therefore differs from the correct one by one day. If we calculate again the longitude of Jupiter for the 27th Kârttika we find it to be 193°30′, interpreted by Table X as the beginning of Svâti, according to Garga and Brahmagupta. The year was therefore Mahâ-Vaiśâkha.

The Ahargaṇa.

50. An element constantly used in Hindu calculations is the *Ahargaṇa*, or the days elapsed since the beginning of the Kaliyuga. Column *Ahar.* in Tables VI-VIII, serves for finding the *Ahargaṇa* for any given date, by summing up the figures in the column for the three parts into which a date is divided; *e.g.* for K.Y. 4163, 19th Phâlguna, we find—

	Ahar.
4100	1497561
63 years	23011
19th Phâlguna	321
Ahargaṇa	1,520,893

By adding 588,466 to the *Ahargaṇa*, we get the corresponding day of the Julian period, in this case 2,109,359. Divide the *Ahargaṇa* or the day of the Julian period by 7; the rest indicates the week-day, counting from Friday =0 for the *Ahargaṇa*, or Monday =0 for the Julian period.

If the *Ahargaṇa* is given, we find the date from the tables in the following way:—Find in Table VI the *Ahar.* nearest to, but smaller than, the proposed *Ahargaṇa*, and subtract it from the latter; with the remainder go through the same operation using Table VII; and with the second remainder apply to Table VIII for the day of the year. The entries of the Index put together will give the date sought.

E.g. the poet Nârâyaṇabhaṭṭa mentions that he finished his *Bhâgavata stotra* on the 1,712,210th day of the Kaliyuga. We find the corresponding date according to the above rule, thus:--

1712210
1680190 = 4600 K. Y.
———
32020
31777 = 87 years.
———
243 = 0 Pausha.

The day intended was K.Y. 4687, 0 Pausha, or A.D. 1586, 28th November.

If instead of the *Ahargaṇa* the day of the Julian period be given, subtract 588,466 from the latter. The remainder is the *Ahargaṇa* with which we proceed as just explained.

The Special Tables.

51. The Special Tables are chiefly intended for calculating *tithis* and other items of Hindu dates according to different *Siddhântas*, after the day and time of the day when the *tithi* ended has been ascertained approximately by means of the General Tables. The General Tables serve as a key for the Special Tables; hence the general arrangement is the same in both. There is, however, this difference, that, while the General Tables refer to mean sunrise at Laṅkâ, the Special Tables for centuries and odd years (XIII and XIV—XIX) refer to the beginning of the mean solar year. The time intervening between this moment and mean sunrise at Laṅkâ is furnished by the column 'Cor.' In order, therefore, to make the calculation for mean sunrise at Laṅkâ by the Special Tables, we must add to, or subtract from, the elements furnished by the tables for the day under consideration, their increase for the time indicated by 'Cor.'[33] The amount of the increase, taken from the Table XXII for *ghaṭikâs* and *palas*, must be added with the sign of 'Cor.' *i.e.* the amount must be added if 'Cor.' is additive, and *vice versâ*.

The Special Tables furnish the astronomical data on which the *tithi* depends, *viz.* the mean distance of sun and moon, the mean anomaly of the moon, and the mean anomaly of the sun. The latter is composed of the anomaly of the sun for the beginning of the century[34] and the mean longitude of the sun for the moment under con-

33 The sign of 'Cor.' in the Special Tables will be found to be the converse of that in the General Tables. But the numerical value is the same in both.

34 As this is practically the same in odd years, the corresponding column has been omitted in the table for odd years.

sideration. These three elements for the several parts into which a date is divided, must be summed up; and complete revolutions rejected.

With the resulting ☾'s anomaly and ☉'s anomay, turn to the Table XXIV, for the equation; take the corresponding equations (interpolating for values intermediate between those in the table), find their sum or difference as the equations are additive or subtractive. The sum or difference, according to its sign, must be added to, or subtracted from, the mean distance to obtain the true distance of sun and moon for the moment calculated. As 12° indicate one *tithi*, we find the number of *tithis* elapsed since the instant of the last conjunction or *amâvâsyâ* by dividing the degrees of the equated distance by 12; the quotient shows how many *tithis* are gone.[35]

Ex.—We have found above (§ 25) that Âshâḍha-sudi 12 K. Y. 3585, occurred on 2nd Śrâvaṇa. Mr. Dîkshit has calculated the same date according to several *Siddhântas*, (*Corp. Insc. Ind.* vol. III, introd. p. 157), and he states that according to the *Sûrya Siddhânta* the 12th *tithi* ended 51 *gh.* 11 *p.* after mean sunrise at Laṅkâ.

First compute K. Y. 3585, 2nd Śrâvaṇa, according to the *Sûrya Siddhânta*:—

	Dist.			☾'s an.			☉'s an.			Cor.
3500 K. Y. .	323°	0′	0″	40°	29′	30″	282°	45′	25″	− 23 *gh.* 52 *p.*
85 years .	126	7	48	268	1	32	0	0	0	+ 0 21
2nd Srâvaṇ .	53	44	23	135	2	33	91	39	39	− 23 31
Sums .	502	52	11	443	33	35	374	25	4	
Or .	142	52	11	83	33	35	14	25	4	

As shown by 'Cor.', we must retrench the increase for 23 *gh.* 31 *p.* to find the value of the elements for mean sunrise at Laṅkâ. But as we have to calculate their amount for 51*gh.* 11*p.* after sunrise, we add that time to 'Cor.' *viz.*— 23*gh.* 31*p.* + 51*gh.* 11*p.* = + 27*gh.* 40*p.* We therefore add the increments for 27 *gh.* 40 *p.* (Table XXII for *ghaṭikâs* and *palas*) to the above result:—

	Dist.			☾'s an.			☉'s an.		
3585 K. Y., 2nd Śrâv. .	142°	52′	11″	83°	33′	35″	14°	25′	4″
27 *gh.* .	5	29	9	5	52	45		26	37
40 *p.* .		8	8		8	42			39
	148	29	28	89	35	2	14	52	20

We have now to find the equation for the ☾'s anomaly. In Table XXIV, we have the equation for ☾'s anomaly 86° 15′ = — 5° 2′ 9″. The difference between the given ☾'s anomaly and this is 3° 20′. The increase of the equation for one minute of anomaly Δ is 0″16, accordingly for 3° 20′ or 200′ it is 32″. Added to the above equation this makes — 5° 2′ 41″.[36]

In the same way we find the equation for the ☉'s anomaly 14° 52′ = + 0° 34′ 4″. The sum of both equations = — 4° 28′ 37, added to 148° 29′ 28″ gives 144° 0′ 51″ for the true distance of sun and moon. As a *tithi* is equal to 12° of distance, 144° marks the end of the 12th *tithi*, and the distance 51″ is equal to about 4 *palas* (Table XXII), by which time the end of the *tithi* occurred before the moment calculated by Mr. Dîkshit.

Let us now calculate the same date according to the *Brahma Siddhânta* and the

[35] In all these calculations care should be had to take the tables for the same *Siddhânta* throughout the process; only Tables XXI and XXII equally apply to all *Siddhântas*.

[36] In this instance it would have been easier to start from anomaly 90°. and subtract the increase for 25′; the resulting equation will then be found to be 5°2′ 42″, which is more correct.

[37] I cannot account for the difference in the result, but I should think that the native method of calculation admits of various abbreviations of the process which in the end bring about a slightly different result.

Siddhânta Śiromaṇi. Mr. Dîkshit finds that the 12th *tithi* ended according to the *Brahma Siddhânta* at 50 *gh.* 15 *p.* after mean sunrise at Laṅkâ, and according to the *Siddhanta Śiromaṇi* at 53 *gh.* 21 *p.* For the *Brahma Siddhânta* (Tables XIII and XVI), we must select the 3rd Śrâvaṇa and not the 2nd:—

	Dist.			☾'s anomaly.			☉'s anomaly.			Cor.	
3500 . .	312°	30′	0″	22°	47′	43″	282°	6′	0″	− 31 *gh.*	52 *p.*
85 years . .	125	52	30	268	27	31	0	0	0	+ 1	58
3rd Śrâvaṇa .	65	55	50	148	6	27	9	38	47	− 29	54
	144	18	20	79	21	41	14	44	47		

The corrections for *Siddhânta Śiromaṇi* (Table XIX) are:—

	Dist.		☾'s anom.		☉'s anom.	
3500	35′	0″	52′	30″	52′	30″
85 years . .	0	39	1	16	1	16
	35	39	53	46	53	46

These corrections must be subtracted from the above result:—

Brahma Siddhânta	144°	18′	20″	79°	21′	41″	14°	44′	47″
	—	35	39	—	53	46	—	53	46
Siddhânta Śiromaṇi	143	42	41	78	27	55	13	51	1

Add 50 *gh.* 15 *p.* to *Cor.* − 29 *gh.* 54 *p.* = + 20 *gh.* 21 *p.* for *Brahma Siddhânta.*
" 53 " 21 " " " " " = + 23 " 27 " " *Siddhânta Śiromaṇi.*

Add the increase to the result for both authorities (Table XXII)—

Brahma Siddhânta	144°	18′	20″	79°	21′	41″	14°	44′	47″
20 *gh.* .	4	3	49	4	21	18		19	43
21 *p.* .		4	16		4	34			21
	148	26	25	83	47	33	15	4	51
Siddhânta Śiromaṇi	143°	42′	41″	78°	27′	55″	13°	51′	1″
23 *gh.* .	4	40	23	5	0	30		22	40
27 *p.* .		5	29		5	53			27
	148	28	33	83	34	18	14	14	8

We find the equations for the *Brahma Siddhânta* (Table XXIV):—

☾ = − 5° 0′ 14″
☉ = + 33 58
Sum = − 4° 26′ 16″

And for the *Siddhânta Śiromaṇi*:—

☾ = − 5° 0′ 7″
☉ = + 32 15
Sum = − 4° 27 52

Applying the sum of the equations to the above results we get by the *Brahma Siddhânta*, 144° 0′ 9″; by the *Siddhânta Śiromaṇi*, 144° 1′ 1″. Accordingly the 12th *tithi* ended before the time stated by Mr. Dîkshit, by less than one *pala* in the case of the *Brahma Siddhânta*, and by four *palas* in that of the *Siddhânta Śiromaṇi.*

Other problems solved by the Special Tables.

52. All problems which depend on the position of the sun and the moon, and which are treated of in the preceding section can be solved, for the several *Siddhântas*, with the greatest accuracy by means of the Special Tables.

True longitude of the Sun.—A calculation of a date as conducted in the preceding paragraphs yields (1) the distance of the mean moon from the mean sun for a particular moment (Dist.), (2) the mean anomaly of the moon, (3) the mean anomaly of the sun for the same time, (4) the equation of mean moon to true moon, (5) the equation of mean sun to true sun, and (6) the true distance between sun and moon.

From (3) and (5) we derive the true longitude of the sun by adding to the mean anomaly of the sun the equation of the sun, but with the sign changed, and then subtracting the mean anomaly of the sun for the beginning of the century. *E. g.* we have found that K. Y. 3585, Âshâḍha sudi 12, ended, according to the *Brahma Siddhânta*, 50 *gh.* 15 *p.* after mean sunrise at Laṅkâ, and that at that moment the mean anomaly of the sun was 15° 4′ 51″; the corresponding equation is + 33′ 58″; applying the equation with the sign changed, we have 14° 30′ 53″. By subtracting the mean anomaly of the sun for the beginning of the century, *viz.* 282° 6′, we have the sun's true longitude 92° 24′ 53″.

53. *True longitude of the Moon.*—If we add the true longitude of the sun to the true distance between sun and moon (5), we get the true longitude of the moon, on which depends the *Nakshatra* and *Râśi* (see § 6).

Here we have 144° + 92° 24′ 53″ = 236° 24′ 53″. The *nakshatra* is Jyeshṭhâ (Table IX) and the *râśi* Tulâ (Table XII). Adding the ☉'s long. to the ☽'s long. we find the *Yoga*, 236° 24′ 53″ + 92° 24′ 53″ = 328° 49′ 46″, *Yoga*: Brahman (Table IX).

54. *The Saṁkrântis.*—The time of all Saṁkrântis according to the *Sûrya Siddhânta* is found in Table XX. If the time, according to another *Siddhânta*, is wanted, we can use the mean longitude of the sun as given at the same place; *e.g.* if it be proposed to find the moment of the Karkaṭa Saṁkrânti in K. Y. 4581, according to the second *Ârya Siddhânta*, we calculate as follows:—

4500 K. Y. ☉'s Anom. .	282° 4′ 2″	Table XVII, *Second Ârya Siddhânta.*
Kark. Saṁkr. „ . .	90° 30′ 28″	
	12° 34′ 30″	Eq. 11° 15′ = + 25′ 28″
Eq. ☉	—0° 28′ 13″	+ 1° 19′ = 2′ 45″
	12° 6′ 17″	Eq. 12° 34′ = + 28′ 13″
Subtract mean an. ☉ . .	—282° 4′ 2″	
True long. ☉ . . .	90° 2′ 15″	

At the moment assumed for the *Saṁkrânti, viz.* 0 Śrâv. 49 *gh.* 48 *p.*, the Saṁkrânti had passed, and the sun had advanced 2′ 15″ beyond the initial point of Karkaṭa. According to Table XXII[38], 2′ 15″ is equal to about 2 *gh.* 17 *p.* by which time therefore the Saṁkrânti, according to the second *Ârya Siddhânta*, preceded the moment calculated. The Saṁkrânti occurred therefore on 0 Śrâvaṇa 47*gh.* 31*p.* This result however does not refer to mean sunrise at Laṅkâ, but to the beginning of the mean solar year. In order to reduce the result to Laṅkâ time, we must find the correction: 4500 = —6*gh.* 22*p.*, 81 years = + 2*gh.* 45*p.*, K. Y. 4581 = — 3*gh.* 37*p.* Sunrise at Laṅkâ preceded the beginning of the mean solar year by 3*gh.* 37*p.* Hence the Saṁkrânti occurred 47*gh.* 31*p.* + 3*gh.* 37*p.* = 51*gh.* 8*p.* after mean sunrise at Laṅkâ according to the second *Ârya Siddhânta.*

55. *Intercalary months.*—If we know the age of the moon at the beginning and end of a solar month, we can decide by the rules in § 31, whether there was an intercalated month or not. We compute the *tithi* at the time of the two Saṁkrântis which

[38] It may be remarked that the minutes and seconds of the mean motion of the sun nearly correspond to as many *ghaṭikâs* and *palas.*

form the beginning and the end of the solar month. As Table XX furnishes the elements on which the *tithi* depends for the time of the Saṁkrânti according to the *Sûrya Siddhânta*, the calculation for that *Siddhânta* will be easy. Let us compute the 2nd example in §31, Bhâdrapada, in K. Y. 4343.

	Distance.	☾'s Anom.	⊙'s Anom.	
4300 . . .	345° 24′ 0″	276° 1′ 30″	282° 43′ 53″	
43 years . .	309 27 14	0 36 36	......	
4343 K. Y. . .	294 51 14	276 38 6	282 43 53	
Siṁha Saṁkr. .	63 6 33	180 54 0	121 31 25	Eq. ☽ — 5° 0′ 11″
	357 57 47	97° 32′ 6″	44° 15′ 18″	Eq. ⊙ + 1 31 25
Sum of Eqs .	—3 28 46			Sum — 3° 28′ 46″
Distance, ☾ — ⊙	354° 29′ 1″			

Accordingly new-moon was still to come.

K. Y. 4343 . .	294° 51′ 14″	276° 38′ 6″	282° 43′ 53″	
Kanyâ Saṁ. .	81 19 14	226 14 1	152 6 4	Eq. ☽ — 3° 3′ 14″
	16 10 28	142° 52′ 7″	74° 49′ 58″	Eq. ⊙ + 2 6 4
Sum of eq. . .	—0 57 10			Sum — 0° 57′ 10″
Distance ☽ — ⊙	= 15° 13′ 18″			

Accordingly new-moon had passed. It follows that there were two new-moons in solar Bhâdrapada, and consequently there was an intercalary Bhâdrapada.

If the calculation is to be based on another *Siddhânta*, we still make use of the elements for the Saṁkrânti as furnished by Table XX. The same calculation will show by what time the Saṁkrânti and by what time the new-moon preceded or followed the moment calculated. It will then be easy to decide the case. To give an example we now calculate the same dates according to the first *Ârya Siddhânta*.

	Dist.	☾'s An.	⊙'s An.	
4300 (T. XIII) .	344° 24′ 0″	274° 24′ 42″	282° 0′ 0″	
43 years (T. XV)	309 22 56	0 15 27	......	
4343 K. Y. .	293 46 56	274 40 9	282 0 0	
Siṁha Saṁkr. (Tab. XX) .	63 6 33	180 54 0	121 31 25	Eq. ☾ — 4° 50′ 0″
				Eq. ⊙ + 1 27 5
	356 53 29	105° 34′ 9″	43° 31′ 25″	Sum — 3° 22′ 55″
Sum of Eqs. .	—3 22 55			
	353° 30′ 34″			

Mean long. ⊙ . . = 121° 31′ 35″

Eq. ⊙ . . = — 1 27 5

True long. ⊙ . . = 120° 4′ 30″

From Table XXII (column ⊙'s long.) we conclude that the Saṁkrânti had occurred 4*gh.* 30*p.* before the moment calculated, and from the same column ☾ — ⊙) that new moon will occur 32*gh.* later; consequently it fell in Bhâdrapada. We now compute the next Saṁkrânti :—

	Dist.	☾'s an.	⊙'s an.	
K. Y. 4343 . .	293° 46′ 56″	274° 40′ 9″	282° 0 0	Eq. ☽ — 3° 9′ 38″
Kanyâ Saṁk. .	81 19 14	226 14 1	152 6 4	Eq ⊙ + 2 3 57
	15 6 10	140° 54′ 10″	74° 6′ 4″	Sum = 1° 5′ 41″
Sum of Eq. =	—1 5 41			
	14° 0′ 29″			

Mean long. ⊙ = 152° 6′ 4″

Eq. ⊙ = 2 3 57

True long. ⊙ = 510° 2′ 7″

Saṁkrânti occurred 2*gh.* 7*p.* before the moment calculated, but new-moon more than a whole day; accordingly this new-moon too belonged to Bhâdrapada, and as there were two new moons in Bhâdrapada, there was an intercalary Bhâdrapada according to the *Ârya Siddhânta* as well as the *Sûrya Siddhânta.*

56. The Special Tables may also be used for computing mean intercalations. For this purpose the subjoined Table, which is similar to that given in § 35, should be employed. To show its working, let us calculate by it the second example in § 35, mean Pausha, in 3741 K.Y., according to the *Brahma Siddhânta.*

	Dist.		
3700 K. Y.	227°	30′	0″
41 years	43	46	30
Mean Pausha	88	31	4
	359°	47′	34″

Accordingly mean new-moon occurred about 1 *gh.* later than the beginning of mean solar Pausha. At the end of the same solar month the distance will be larger by 11° 3′ 53″. It follows that the distance will come out 10° 51′ 27″ for the end of mean Pausha. By Table XXII it will be seen that this amount of difference corresponds to more than 58 *gh.* by which time accordingly new-moon preceded the end of Pausha. As there were two mean new-moons in mean solar Pausha, there was due a mean intercalary month, which by the common rule was Pausha; but by the rule of the *Brahma Siddhânta* itself quoted above (§ 10, note 7), the month would have been an intercalated mean Mârgaśira.

Mean solar month.	Distance. ☾ − ⊙		
(Chaitra pr. y.)	(348°	56′	7″)
Vaiśâkha .	0	0	0
Jyaishṭha .	11	3	53
Âshâḍha .	22	7	46
Śrâvaṇa .	33	11	39
Bhâdrapada .	44	15	32
Âśvina .	55	19	25
Kârttika .	66	23	18
Mârgaśira .	77	27	11
Pausha .	88	31	4
Mâgha .	99	34	57
Phâlguna .	110	38	50
Chaitra .	121	42	43
(Vaiś. fol. yr.) .	(132	46	36)

Corrections for true local time.

57. The calculations taught above yield the astronomical data in mean Laṅkâ time, reckoned from mean sunrise at Laṅkâ. The Hindus, however, actually employ true local time, reckoned from true sunrise at the place of the observer or computer. Therefore, in order to make the results square with the latter, we must apply to the result in Laṅkâ time the following corrections.

58. *Correction for mean local time.*—Mean local time is reckoned from mean sunrise at the point on the Equator which has the same longitude with the place under consideration. This correction is found by the difference in longitude between Ujjain and the given place. The difference in minutes is at once the interval sought in *asus,* six of which make a *vinâḍî.* In Table XXV the interval between mean Laṅkâ and local time is given for a considerable number of places. If the place is east of Laṅkâ (*i.e.* Ujjain), the sign + is prefixed to the interval; if west, the sign —. The interval applied, according to its sign, to Laṅkâ time gives mean local time.

Let it be proposed to find the true *tithi* for 4300 K. Y. 28th Bhâdrapada at Aṇhilwâḍ, on the basis of the first *Ârya Siddhânta,* corrected. Mean Aṇhilwâḍ time differs from mean Laṅkâ time by —40 *vin.*; therefore, the mean sun rises 40 *vin.* later on the meridian of Aṇhilwâḍ than at Laṅkâ. We combine these 38 *vin.* with 'Cor.' in

order to find the values of distance of sun and moon, &c., for mean sunrise on the meridian of Aṇhilwâḍ.

	Dist.			☾'s.	an.		⊙'s.	an.		gh.	p.
4300 K. Y. . . .	344°	24′	0″	274°	24′	42″	282°	0′	0″	—19	35
28th Bhâdrapada .	28	36	45	169	44	44	147	50	25	+ 0	40
	13	0	45	84	9	6	69	50	25	—18	55
—18 *gh.* 55 *p.* . .	—3	50	36	4	7	9	0	18	38		
At mean sunrise Aṇhilwâḍ	9	10	9	80	1	57	69	31	47		

59. An element wanted for the further correction is the tropical longitude of the mean sun, which is equal to the sidereal longitude of the sun plus the *ayanâṁśas* for the year. The sidereal longitude of the mean sun is obviously equal to the mean anomaly of the sun for the date calculated minus the mean anomaly for the beginning of the century; here 69° 31′ 47″—282°=147° 31′ 47″. The *ayanâṁśa* are 3 × (4300—3600) ÷ 200 = 10° 30′ (see § 39). Accordingly the tropical longitude of mean sun is 147° 31′ 47″ + 10° 30′ = 158° 1′ 47″ or 5^s 8° 1′ 47″.

60. *Correction for terrestrial latitude.*—This correction is combined with another which is necessitated by the obliquity of the ecliptic. Table XXVI gives the time in *asus* (6 *asus* = 1 *vinâḍî*) which each of the tropical signs takes in rising above the horizon on the parallel of latitude marked at the head of the vertical columns. We sum up the *asus* of the signs past, in this case 5 signs for 24° north, which is nearly the latitude of Aṇhilwâḍ. Signs I—V inclusive give 1353+1533+1829+2041+2057=8813. Now we have this proportion: as the 30 degrees of sign VI rise in 1987 *asus*, 8° 1′·7 rise in 532 *asus*. Adding this to 8813 we get 9345 *asus* which the part of the ecliptic, through which the mean sun has passed, takes up in rising. Converting the sun's tropical longitude into minutes, we find 5^s 8° 21′ = 9482′; this is the time in *asus* which an arc of the Equator equal to the mean longitude of the sun takes in rising. Subtracting the one from the other, 9482—9345 = 137, we obtain the interval in *asus* between the rising of the mean sun assumed to move on the Equator and that on the ecliptic. When the sun is in one of the first six signs, I—VI, he rises earlier in a northern latitude than on the Equator; if in the last six signs, VII—XII, he rises later. In this case the sun, being in sign VI, rises earlier than calculated by 137 *asus*, which divided by 6 give the amount in *vinâḍîs*, *viz.* 23. Therefore, we subtract from the element *Dist.* &c., as found above, their increase in 23 *palas*—

	Dist. ☾—⊙			☾'s	an.		⊙'s	an.	
	9°	10′	9″	80°	1′	57″	69°	31′	47″
Table XXII, 23*p.*	—0	4	40	0	5	0	0	0	22
	9	5	29	79	56	57	69	31	25
Sum of Eq.	—2	55	39						
Dist. of ⊙ & ☾ .	6°	9′	50″						

☾ an. 79°	57′	eq.	—	4°	56′	24″
⊙ an. 69	31	eq.	+	2	0	45
Sum of equations			—	2	55	39

Thus we get 6° 9′ 50″ as the true distance of sun and moon at the true rising of the mean sun at Aṇhilwâḍ.

61. *True Sunrise.*—In § 52 we have seen that the true longitude of the sun is derived from the mean longitude by adding the sun's equation with the sign changed; consequently the ⊙'s true longitude is greater or less than his mean longitude by the amount of the equation, according as the sun's equation in Table XXIV has the sign —

or +. It is evident that the true sun rises later than the mean sun if the true longitude is greater than the mean, and *vice versâ*. In the present case, the equation being additive, true sunrise precedes mean sunrise.

We have now to find in how much time the part of the ecliptic equal to the ☉'s equation rises on the given parallel.

Convert the ☉'s equation into minutes, *viz.* 121′; multiply this by the *asus* which the tropical sign, through which the sun is passing, takes in rising, 1987, and divide by 1800. The result 135 is the interval in *asus* between the rising of the true and the mean sun. Divide this by 6, the quotient 23 is the interval in *vinâḍîs*. The increase of distance for the interval thus found must be added to the corrected distance if the equation in Table XXIV is subtractive, or subtracted if the equation is additive. Here—

Distance	6°	9′	50″
—23 *vin.*—	0	4	40
True Dist.	6	5	10

This is the final result. It will be seen from Table XXII, that 26 *p.* (the time corresponding to an increase of distance = 5′ 10″) before true sunrise, the first *Karaṇa* had ended.

It should, however, be remarked that if the interval between true sunrise and the end of a *tithi*, &c. is *very* small, say a few *palas*, the case must be regarded as doubtful; for, though our calculations materially agree with those of the Hindus, still an almanac-maker avails himself of abbreviations which in the end may slightly influence the result (*vide inf.*).

62. *Dates anterior to Bhâskara* (K. Y. 4251).—In the *Siddhânta Śiromaṇi, Golâdhyâya*, iv, 20, Bhâskara states that the ancient astronomers assumed that at Laṅkâ (or on the Equator) the zodiacal signs rise in the same time with 30 degrees of the equinoctial, or, in other words, that the *udayâsu* of all signs are 1800′. On this condition the entries in Table XXVI require a correction exhibited in column *Chara*, as explained at the foot of the table, *e.g.* the column 24° would, on this supposition, show the following figures—1483, 1538, 1694, 1906, 2062, 2127, instead of 1353, &c. It is obvious that in calculating dates anterior to Bhâskara's time, the *asus* in Table XXVI should be corrected in the way explained.

If we knew the Hindu estimate of the latitude and longitude of the place for which the calculation is to be made, the result would of course be the same as that arrived at by a Hindu calculator. As yet, however, we do not know the Hindu latitude and longitude of any place, but substitute for them their true values. It is obvious that the error in the Hindu estimate of the geographical site of a given place influences the result, from which our result, calculated on absolutely correct data, may differ considerably. Therefore, so long as we ignore the Hindu latitude and longitude of the places for which almanacs were constructed, our calculation, though theoretically correct, must yield discordant results. I may therefore be allowed to appeal to native astronomers to collect and furnish us with a list of the latitudes and longitudes of the principal places of India, as employed by ancient Joshîs.

Examples of General Application.

1. To find the European date corresponding to a given Hindu lunar one.

This may be effected by §§ 20-26. But we may calculate also by means of the column for 'Julian Calendar' in the tables. Thus in Ex. 1, § 26, we have Saṁ. 1233, Bhâdrapada Sudi 13, Sunday, corresponding to K. Y. 4276, 3rd Âśvina, solar reckoning; and :—

	Fer.	Tithi.	☾'s An.	Jul. Cal.
K. Y 4200	(1)	2·19	693	9
76 years	(5)	1·27	456	2 7
3rd Âśvina	(2)	8·83	661	20=1~~4~~+3 Aug.
Sun	(1)	eq. 0·03	814	31st Aug.
		13·32, Bhâdrapada sudi.		

4276—3101=1175 A.D., 31st August, Sunday.

2. To convert a European date into a Hindu lunar date. Find (*a*) the corresponding Kaliyuga year by adding 3101 or 3100 as the case requires; (*b*) by § 21 find the date corresponding to the Julian day, and by § 23 compute the corresponding *tithi;* (*c*) the lunar month is of the same name as the solar month in which the new moon preceding the date falls, except when the date belongs to the dark fortnight *and* is to be interpreted according to the *Pûrṇimânta* scheme,—when the lunar month takes the name of the following solar month; (*d*) if the Vikrama era, beginning generally in Kârttika, is used, the lunar months Chaitra to Kârttika in Table III belong to the preceding year; and (*e*) if the date is in New Style, it must first be converted into Old Style.

Ex. 1. To find the Hindu date corresponding to 1st June 1891. 1st June 1891 corresponds to 20th May (O. S.), K. Y. 4992. By §21, 16+1+14 April=1st May for 0 Jyaishṭha. Hence 20th May O. S. corresponds to 19th Jyaishṭha of the Tables. Now by Tables I-III :—

	Fer.	Tithi.	☾'s An.	Jul. Cal.
K. Y. 4900 . .	(0)	7·41	783	15
92 . .	(4)	28·16	514	2
19 Jyaish. . .	(5)	17·83	706	33 = 19 + 14 April.
Mon. .	(2) eq.	0·42	3	50th ~~May~~ April = 20th May.
		23·82 or 8·82 badi, *i. e.*, badi 9.		

The date belonging to the dark fortnight, about the 24th day of the moon's age, new moon must have occurred before 1st Jyaishṭha, or towards the end of Vaiśâkha; hence in the *Amânta* scheme the date is Vaiśâkha badi 9, K. Y. 4992 or Śaka 1813; but being before Kârttika, it is in Saṁvat 1947. In the *Pûrṇimânta* scheme it is Jyaishṭha badi 9.

Ex 2. For 11th February 1878.

11th February is 30th January O. S. and this falling before Chaitra, the year K. Y. is 4978. 0 Phâlguna=16+13 January=29th January. Hence 30th January=1st Phâlguna. Then—

	Fer.	Tithi.	☾'s An.	Jul. Cal.
K. Y. 4900 . .	(0)	7·41	783	15
78 . .	(0)	22·87	949	1
1st Phâlg. . .	(2)	7·88	996	14 = 1 + 13 Jan.
Mon. .	(2) eq.	0·00	728	30th Jan.
		8·16 Mâgha sudi.		

Hence the 9th tithi sudi ended on Monday, 30th January O. S., or 11th February N. S., and new moon occurred about 23rd Mâgha; hence the date in both schemes is Mâgha sudi 9, Śaka 1799 or Saṁvat 1934.

On the construction of the Tables.

63. Tables I and II are so constructed that the common and leap years are distributed in such a way that the end of the tabular year differs from the end of the corresponding mean solar year of the Hindus[39] by an interval (indicated by '*Cor.*') rarely exceeding 60 *ghaṭikâs*, but generally much less. As 100 solar years of the Hindus contain 36,526 days less about $\frac{1}{8}$th day, the centuries in table I contain 84 common and 26 leap years, except that in every eighth century there are only 25 leap years. The leap years in the century are so placed that '*Cor.*' is kept under 30 *ghaṭikâs*.

64. *Calculation of the 'correction.'*—As '*Cor.*' is the fraction of the day by which the sum of the solar years is more or less than an integral number of days, this fraction depends on the length of the solar year; and the latter depends on the days in one *Yuga* according to the different *Siddhântas;* that is, the sum of days in a *yuga* divided by the number of solar years in a *yuga* (*viz.* 4,320,000) gives the length of the solar year.[40] Thus:—

	Days in a yuga.	Length of a solar year.					
Sûrya Siddhânta . .	1,577,917,828	365·258756481 days or	365 d.	15	gh.	31·52	p.
Ârya Siddhânta . .	1,577,917,500	365·258680555	,, 365 ,,	15	,,	31·25	,,
2nd Ârya Siddhânta . .	1,577,917,542	365·258690278	,, 365 ,,	15	,,	31·28	,,
Brahma Siddhânta . .	1,577,916,450	365·258437599	,, 365 ,,	15	,,	30·37	,,

From these data is derived the mean duration of 100, 1000 and 3000 years according to the different authorities. Thus according to the *Ârya Siddhânta*, 3000 years being 1,095,776*d.* 2*gh.* 30*p.*, the '*Cor.*' is + 2*gh.* 30 *p.* As the astronomical day in the *Sûrya Siddhânta* begins with mean midnight at Laṅkâ, while common use makes it begin with mean sunrise at Laṅkâ from the duration 1,095,776*d.* 16*gh.* 10*p.*, we must retrench 15 *ghaṭikâs* (the time between mean midnight and mean sunrise), the remainder + 1 *gh.* 10 *p.* is the required '*Cor.*' as entered in the table. But according to the *Brahma Siddhânta*, 3,000 solar years contain 1,095,775*d.* 18*gh.* 45*p.* or about one day less than is given by the other *Siddhântas;* 3000 K.Y. therefore began on the day preceding that entered in the tables, and the '*Cor.*' was + 18*gh.* 45*p.*

65. *Calculation of the week day* (*Feria*):—*Kaliyuga* began with a Friday, or according to our notation the Feria was (6). Now as 3,000 solar years contain 1,095,776 days or 156,539 weeks + 3 days, 3000 K.Y. began on (6) + (3) = (9) or (2) = Monday. Again as a century of 36,526 days contains exactly 5,218 weeks, it follows that after the lapse of such a century the week-day will be found the same as at the beginning of it. But after a century of 36,525 days the week-day must retrograde by one day. In this way the Feriæ of Table I have been ascertained. In Table II, the week-day advances by one day after every common year (of 365 days), and by two days after a leap year (of 366 days). The advance of F. by 2 in Table II therefore shows that the preceding tabular year consists of 366 days.

66. *Verification of a date in the Tables.*—The *Kaliyuga* began on the 18th February 3102 B.C., after the 588,465th complete day of the Julian period. As 4,000 solar years

[39] The Hindu solar year is the *sidereal* year. The *tropical* year on which European Chronology is based is hardly ever used by the Hindus. So also, in Hindu astronomy the revolutions of the planets, &c., are sidereal, and not tropical. The precession of the equinoxes is taken into account in such cases as are affected by it, but it is neglected in all others.

[40] The European value of this sidereal year is 365·2563744 days, while the *tropical* year consists of 365·24224 days; and taking the precession of the equinoxes at 180 revolutions in a *yuga*, according to the *Sûrya Siddhânta*, the Hindu tropical year would be 1,577,917,828 ÷ 4,320,180 = 365·243539667 days.—J.B.

of the Hindus contain 1,461,035 days, they are equal to 40 centuries of Julian years plus 35 days. Therefore 4000 K.Y. began on 18th February + 35 days = 26th March.[41] The same date will be yielded by the tables if the 3rd Vaiśâkha or beginning of the mean solar year of 4000 K.Y. is calculated. We may also test the Julian date by calculating the *ahargaṇa*, or civil days from the commencement of the Kaliyuga, by tables VI, VII, VIII, and adding 588,465, the result being the corresponding day of the Julian period, which can readily be converted into the corresponding day of the Julian Calendar by the usual tables.

67. *Construction of the Special Tables XIII—XXI.*—The Special Tables are based on the mean solar year, and not on the artificial year introduced in the General Tables. It is evident that '*Cor.*' must denote the same interval of time in both sets of tables, but with a contrary sign, because in the General Tables, the artificial year being given, '*Cor.*' serves to find the end of the solar year, and in the Special Tables the solar year being given, it serves to find the end of the artificial year, *i.e.* the interval between the end of the solar year and the beginning of the next preceding or following sunrise at Lankâ.

68. *To calculate a given Tithi.*—As a *Tithi* is equal to the time required by the sun and moon to increase their distance by 12° of longitude, we require the following data: (1) the true longitude of the moon, (2) the true longitude of the sun. According to Hindu astronomy, true long. ☾ = mean long. ☾ ± equation of the ☾'s centre; and true long. ☉ = mean long. ☉ ± equation of the ☉'s centre. The equations of the sun and moon's centres depend on their mean anomalies. Now we have the equations: true distance ☾ − ☉ = true long. ☾ − true long. ☉ = mean long. ☾ − mean long. ☉ ± equation ☾ ± equation ☉. The mean long. ☾ − mean long. ☉ is equal to the place of the moon in her synodical revolution. Hence it follows that the tables must enable us to calculate accurately—

(1) the synodical motion of the moon,
(2) the anomalistic motion of the moon,
(3) the anomalistic motion of the sun.

Besides this we require tables furnishing the equation for (2) and (3).

69. The synodical motion of the moon (Tables XIII to XIX) in one solar year is evidently equal to the synodical revolutions of the moon in a *yuga* divided by the number of solar years in a *yuga*. The moon's synodical revolutions in a *yuga* are, in the *Sûrya Siddhânta* and *Ârya Siddhânta* 53,433,336;[42] *2nd Ârya Siddhânta* 53,433,334; *Brahma Siddhânta* 53,433,330. Dividing these figures by 4,320,000 and multiplying by 360°, we find the mean synodical motion in degrees for one solar year, *viz. Sûrya* and *Ârya Siddhânta*—rejecting complete revolutions or multiples of 360°, = 132° 46′ 40·8″ in 100 solar years: 317° 48′, &c.

As the mean distance of the sun and moon at the beginning of the Kaliyuga was 0° (the longitude of both being supposed to have been 0°), the mean distance ☾ − ☉ at 3000 K.Y. was 174° as given in column headed 'Distance' ☾ − ☉ of Table XIII. From these data the value of the distance for centuries and for odd years can easily be computed; in a similar way the corresponding values for the other *Siddhântas* have been computed.

[41] The Julian date advances by one day after each century of 36,526 days, but remains the same after a century of 36,525.

[42] Hence the synodical period of the *S. S.* is $s = 1,577,917,828\ d. \div 53,433,336\ r. = 29{\cdot}53058795$ days.—J.B.

70. The daily synodical motion of the moon[43] in degrees is, according to the *Sûrya Siddhânta*, 12° 11′ 26″·69817, as given in the translation of the *Sûrya Siddhânta* (*Journ. Am. Or. Soc.*) i, 34. This value is practically the same for the other *Siddhântas* also, for the difference in a year amounts to 2 seconds only for the 2nd *Ârya Siddhânta*, and to 1 second every month for the *Brahma Siddhânta*. For the latter *Siddhânta* therefore we get the correct value, if we add to that furnished by Table XIV one second for each month elapsed since the beginning of the solar year.

71. The calculation of the *anomalistic motion* of the moon is similar to that of the synodical motion. The anomalistic revolutions of the moon in one yuga—are (1) *Sûrya Siddhânta* 57,265,133;[44] (2) *Ârya Siddhânta* 57,265,117; (3) *2nd Ârya Siddhânta* 57,265,125·326; and (4) *Brahma Siddhânta* 57,265,194·142.

According to the *Sûrya Siddhânta*, the anomalistic motion in one solar year is 92° 5′ 39·9″; and in 100 solar years, 209° 26′ 30″, &c.

72. As the position of the moon's apogee at the beginning of the Kaliyuga was 90° according to the *Sûrya* and *1st Ârya Siddhântas*, the mean anomaly was 270°; and as in 3000 solar years the increase of the anomaly, according to the *Sûrya Siddhânta*, is 163° 15′, the mean anomaly of the moon at 3000 K. Y. was 73° 15′ as in the Special Table XIII for the *Sûrya Siddhânta*, in the column headed ☾'s Anom. From the above data the value of this element for the other periods is computed.

73. In calculating the mean anomaly of the moon for the *2nd Ârya Siddhânta* and the *Brahma Siddhânta*, we must add to the increase of ☾'s an. 236° 9′ 36″ and 234° 30′ 14″ respectively as the anomaly of the moon at the beginning of the Kaliyuga; for the position of the moon's apogee at that epoch was according to the *2nd Ârya Siddhânta* 123° 50′ 24″ and according to the *Brahma Siddhânta* 125° 29′ 46″.

The daily increase of the moon's mean anomaly according to the *Sûrya Siddhânta* is 13° 3′ 53″·889; and the other *Siddhântas* yield nearly the same result. The difference accumulating to a few seconds in a year may be neglected, as it does not sensibly affect the calculation of the true place of the moon.

74. The *mean anomaly of the sun* is the sun's mean longitude minus the longitude of the sun's apogee. As the sun's mean longitude at the beginning of a mean solar year is 0° (or 360°), we subtract long. ☉'s apogee from 360°, in order to find the sun's mean anomaly for the beginning of the mean solar year.

75. The long. of ☉'s apogee, according to the *Ârya Siddhânta*, is 78° and this quantity is regarded as constant.[45] Therefore the mean anomaly of the sun for the beginning of every mean solar year is 282° according to this *Siddhânta*.

The other *Siddhântas*[46] attribute a slow motion to the sun's apogee, *viz.*:—

The sun's apogee.

	Revol. in a Kalpa.	Position at 0. K. Y.	Mean anom. ☉ at 0 K. Y.
Sûrya Siddhânta :	387	77° 7′ 48″	282° 52′ 12″
2nd Ârya Siddhânta :	461	77° 45′ 36″	282° 14′ 24″
Brahma Siddhânta :	480	77° 45′ 36″	282° 14′ 24″

43 This is found by dividing 360° by the synodical period; see preceding note.—J. B.

44 Hence the anomalistic revolution takes place in g = 1577,917,828d.÷57,265,133 rev. = 27·5545999 days; and the daily motion = 360° ÷ g = 13° 3′ 53″·889.—J. B.

45 In European astronomy the longitude increases by about 11·″25 from the motion of the apsides.—J. B.

46 *Sûrya Siddh.* N. S. I. 44.

The motion in seconds in one solar year, according to the *Sûrya Siddhânta*, is thus 0·″1161; similarly for the *2nd Ârya Siddhânta* it is 0·″1383, and for *Brahma Siddhânta* 0·″144. Subtracting the amounts for 3000 years from the sun's mean anomaly for 0 K.Y., we find the same for 3000 K.Y., *viz.* (1) 282° 46′ 24″; (2) 282° 7′ 29″; (3) 282° 7′ 12″; as entered in Table XIII in the column headed ⊙'s an.

76. The tables for the equations of the centres of the sun and moon are calculated from the epicycles. Their dimensions are the following:—

	According to *Ârya S.*	*2nd Ârya S.*	*Brahma S.*
Epicycle of the moon	31° 30′	31° 34′	31° 36′
Epicycle of the sun	13 30	13 40	13 40

Now according to Hindu astronomy, sin. eq.: sin. an. :: minutes in the epicycle : minutes in the orbit.

In all these calculations the Hindu sines have to be used. Thus we find *e.g.* the eq. ☾ for ☾'s an. =45° (sin 45°=2431′), according to the first *Ârya Siddhânta*, 212·′71= 3° 32′ 43″; according to the second *Ârya Siddh.* 213·′65=3° 33′ 39″.

77. The epicycles of the moon and sun, according to the *Sûrya Siddhânta*, have circumferences of 32° and 14° respectively, and are assumed to contract at the odd quadrants by 20′. The amount of the contraction at any other point, say at anom. a, is $\frac{20 \times \sin. a}{3438}$; hence the equation of the sun's centre for anomaly a is $= \sin \frac{32}{360} a - \frac{20 \times \sin.^2 a}{3438 \times 360 \times 60}$, which formula will be found convenient for the calculation of the table. This has been done by Davies (*As. Res.* vol. II, p. 256); I have taken Davies' tables from Warren's *Kala Sankalita*, Tables XXII and XXIII.

78. The *General Tables* yield approximately correct results with the smallest amount of calculation; but they do not conform strictly to the data of any *Siddhânta*, but are based on the European tables of Largeteau[47] with this difference that while Largeteau expresses the mean distance of sun and moon, a, in 10,000th parts of the circle, these tables furnish the same element, called *tithi*, in 30th parts of the synodical revolution. But the mean anomaly of the moon is expressed in the same way in both. For 3200 K.Y. = 99 A.D. 18th March, Largeteau's tables give a=moon's age 2575, and b=857, for mean midnight at Paris. Reducing this for mean sunrise at Lankâ we must add the increments of a and b for $1^h\ 6^m$, *viz.* 15 and 2, which give $a = 2590$ and $b = 859$. From a we subtract 200 (the sum of the equations of ☾ and ⊙ at their maximum), multiply by 30, and divide by 10,000; which gives 7·17 the required *tithi* for 3200 K.Y. as in Table I. The value of b found above, 859,[48] is transferred to column ☾'s an. of Table I without further change. The same elements in Table II can easily be derived from Largeteau's Table for the years of the 9th century, attention being paid to the leap years.

[47] *Additions a la Connaissance des Temps, 1846*, pp. 1—29, containing *Tables pour le calcul des Syzygies écliptiques ou quelconques*; par M. C. L. Largeteau. These short tables are founded on those of Delambre for the sun and of Damoiseau for the moon, and take only the larger equations into account. M. Largeteau uses six quantities in his tables, but does not explain what each indicates; they are,—a = moon's age (or distance from the sun) in 10,000ths of a lunation—300 (sum of negative equations); b = moon's mean anomaly (Hansen's g); $c = 2a - b$; d = sun's mean anomaly (Hansen's g'); e = moon's distance from the Node or Hansen's $g + \omega$; and f = sun's distance from Moon's Node or $2e - 2u$ (that is Hansen's $2g' + 2\omega'$). The last four quantities are given in 1000th parts of the circumference. Similar handy tables, but sexagesimal, and with more equations were published in the seventh edition of the *Encyclopædia Britannica*, and others in Gummere's *Astronomy* (Philadelphia 1858).—J. B.

[48] If the degrees in 'Distance ☾ — ⊙' Table XIII, &c., be multiplied by 30 we obtain this element a according to the different *Siddhântas*; thus for K.Y. 3200 we have 89°·6 × 30 = 2688; or if we divide the same by 12, we have 7·47 tithi. Again for b, from Table XIII, 132° 10′ × 100 ÷ 36 = 367, and 367 — 500 = 867, differing by about 3° from the European value. Hansen's *Tables de la Lune* give for the value of the tithi here, 7·1637 and for ☾'s anom.= 858·11.—J. B.

79. As the beginning of the mean solar year (*i.e.*, mean long.⊙=0) always falls on the 2nd or 3rd Vaiśâkha of Table III, it is obvious that on any given date in that table the ⊙'s mean long. and consequently the ⊙'s mean anomaly and the equation dependent on the latter will be nearly the same for every year. Accordingly the equation ⊙ has been coupled with the *tithi* of the several solar days, so that only the equation of the moon's centre had to be exhibited in the table auxiliary to Table III. 'Sun from Node' of Tables VI, VII, VIII, denotes the distance of the *true* sun from the moon's node expressed in thousandth parts of the semi-circle. This element has been derived from Largeteau's tables[49] by coupling Largeteau's values with the equation of the sun's centre.

80. 'Jupiter's saṁvat' is the Jovian year, according to the *Sûrya Siddhânta* with *bîja*, twelve of which make up one mean revolution of Jupiter. Hence the increase of this in one solar year is evidently equal to twelve times the revolutions of Jupiter in a *yuga* divided by the number of solar years in the *yuga*, *viz.* 1·0117. The increase for 100 solar years is 101·17, or, as 60 years make up one cycle, 41·17. In making these calculations according to the *2nd Ârya Siddhânta* and *Brahma Siddhânta* the mean place of Jupiter at the beginning of the Kaliyuga is to be taken into account, *viz.* 357° 7′ 12″ according to the former, and 359° 27′ 36″ according to the latter *Siddhânta.*

81. The tables for finding *true local time* have been calculated according to the precepts of the *Siddhânta Śiromaṇi*, *Golâdhyâya*, IV, 19-24, and *Sûrya Siddhânta*, III, 42ff.

82. The Longitudes and Latitudes of the principal places in India have been taken partly from Johnston's *Index Geographicus*, and partly from the list attached to the *Sâyana Pañchâṅga* of Bombay.

The longitude of Laṅkâ *i.e.* Ujjain is $5^h\ 3^m\ 27^s$ east of Greenwich.

83. The following is a list of all the data required from the *Siddhântas*—

Elements.	*Sûrya Siddh.*	*Ârya Siddh.*	*2nd Ârya Siddh.*	*Brahma Siddh.*
Sun's revol. in a Yuga . .	4,320,000	4,320,000	4,320,000	4,320,000
Civil days „ „ . . .	1,577,917,828	1,577,917,5[illegible]0	1,577,917,542	1,577,916,450
Lunar tithis „ „ . . .	1,603,000,080	1,603,000,080	1,603,000,000	1,602,999,000
Moon's synod. revol. in a Yuga .	53,433,336	53,433,336	53,433 334	53,433,300
„ sider. „ „ . .	57,753,336	57,753,336	57,753,234	57,733,300
„ anom. „ „ . .	57,265,133	57,265,117	57,265,125·326	57,265,194 142
„ nodes „ „ . .	—232,238[50]	—232,226	—232,313·354	—232,311·168
„ apsides „ „ . .	488,203	488,219	488,108·674	488,105·858
Jupiter's revol. „ „ . .	364,220[51]	364,224	...	364,226·455
Revol. of ⊙'s apsis in a Kalpa .	387	not stated.	461	480
Circumference of the ⊙'s epicycle .	14° & 13° 40′	13° 30′	13° 40′	13° 40′
„ „ ☾'s „ .	32° & 31° 40′	31° 30′	31° 34′	31° 36′
Place of ⊙'s apsis at 0 K. Y. .	77° 7′ 48″	78°	77° 45′ 36″	77° 45′ 36″
„ „ „ ☾'s „ .	90°	90°	123° 50′ 24″	125° 29′ 46″
„ Jupiter at 0 K. Y. . .	0°	0°	357° 7′ 12″	329° 27′ 36″

49 Largeteau's *f*, or Hansen's $2g' + 2\omega'$ is the mean value, independent of the Sun's equation of the centre. the correct period of which is 173·30998176 days; or, from the *Sûrya Siddhânta* elements it may be found thus: 1577917828÷2(4320000+232238)=173·3123167 days.—J. B.

50 In the *Sûrya Siddhânta* with *bîja*, this is—232,242 rev.; the apsides make 488,199 rev.; and Jupiter 364,228 rev. The modern value of the mean heliocentric motion of Jupiter in a Julian year being 30° 20′ 46″·72, his motion in a *Yuga* of 4,320,000 true sidereal years would be only 364195·406 revolutions; or, in the *yuga* of the *Sûrya Siddhânta*, 364,197·798 rev. and twelve times this divided by the years in a *yuga* gives 1·011938328 instead of 1·0117 as in § 78.—J. B.

51 With *bîja* this becomes 364212.

TABLE I.—*For Centuries of the Kaliyuga.*[1]

Years K. Y.	Feriæ.	Tithi.	Moon's M. Anom.	Jul. Cal.	*Ârya-Siddh.* gh. p.	*Sûrya-Siddh.* gh. p.	*Brahma Siddh.* gh. p.	*Siddh. Sirom.* gh. p.
	LUNI-SOLAR DATA.				CORRECTIONS FOR SOLAR DATES.			
3000	2	13·97	685	−2	+ 2 30	+ 1 10	+18 45	
3100	2	10·57	272	−1	− 5 25	− 6 18	9 22	
3200	2	7·17	859	0	13 20	13 46	0 0	
3300	2	3·77	446	+1	21 15	21 13	− 9 23	
3400	2	0·37	34	2	30 10	28 41	18 45	
3500	1	25·96	585	2	+22 55	+23 52	+31 52	
3600	1	22·56	172	3	15 0	16 24	22 30	
3700	1	19·17	759	4	7 5	8 56	13 7	
3800	1	15·77	348	5	− 0 50	1 29	3 45	
3900	1	12·37	936	6	8 45	− 5 59	− 5 37	
4000	1	8·98	523	7	−16 40	−13 27	−14 59	
4100	1	5·58	111	8	24 35	20 54	24 22	−22 41
4200	1	2·19	699	9	32 30	28 22	33 44	30 41
4300	0	27·78	251	9	+19 35	+24 10	+16 53	+21 27
4400	0	24·38	840	10	11 40	16 43	7 31	13 35
4500	0	20·99	428	11	+ 3 45	+ 9 15	− 1 52	+ 5 45
4600	0	17·60	15	12	− 4 10	1 47	11 14	3 6
4700	0	14·20	605	13	12 5	− 5 40	20 37	9 58
4800	0	10·81	194	14	20 0	13 8	29 59	17 49
4900	0	7·41	783	15	27 55	20 36	39 22	25 40
5000	6	3·00	337	15	+24 10	+31 57	+11 16	+26 30

TABLE II.—*Years of the century.*

FOR ODD YEARS—(0-24).

Year.	Feriæ.	Tithi.	☽'s Anom.	Jul. Cal.	Solar Cor. *Â. S.* gh. p.
0	0	0	0	1	0 0
1	1	10·80	246	0	+15 31
2	2	21·60	493	0	+31 2
3	4	3·42	776	1	−13 26
4	5	14·22	22	1	+ 2 5
5	6	25·03	269	0	+17 36
6	0	5·83	515	0	+33 7
7	2	17·65	798	1	−11 20
8	3	28·45	44	1	+ 4 10
9	4	9·25	291	0	+19 41
10	5	20·05	537	0	+35 12
11	0	1·87	820	1	— 9 16
12	1	12·67	66	1	+ 6 15
13	2	23·47	313	0	+21 46
14	4	5·29	595	1	−22 43
15	5	16·09	842	1	− 7 11
16	6	26·89	88	1	+ 8 20
17	0	7·70	335	0	+23 51
18	2	19·51	618	1	−20 37
19	3	0·32	864	1	− 5 6
20	4	11·12	110	1	+10 25
21	5	21·92	357	0	+25 56
22	0	3·74	640	1	−18 33
23	1	14·54	886	1	− 3 1
24	2	25·34	133	1	+12 30

FOR ODD YEARS—(25-49).

Year.	Feriæ.	Tithi.	☽'s Anom.	Jul. Cal.	Solar Cor. *Â. S.* gh. p.
25	3	6·14	379	0	+28 01
26	5	17·96	662	1	−16 28
27	6	28·76	908	1	− 0 56
28	0	9·57	155	1	+14 35
29	1	20·37	401	0	+30 6
30	3	2·19	684	1	−14 23
31	4	12·99	930	1	+ 1 9
32	5	23·79	177	1	+16 40
33	6	4·59	423	0	+32 11
34	1	16·41	706	1	−12 18
35	2	27·21	952	1	+ 3 13
36	3	8·01	199	1	+18 45
37	4	18·82	445	0	+34 16
38	6	0·63	728	1	−10 13
39	0	11·44	971	1	+ 5 19
40	1	22·24	221	1	+20 50
41	2	3·04	467	0	+36 21
42	4	14·86	750	1	− 8 8
43	5	25·66	997	1	+ 7 24
44	6	6·46	243	1	+22 55
45	1	18·28	526	1	−21 33
46	2	29·08	772	1	− 6 3
47	3	9·88	19	1	+ 9 28
48	4	20·68	265	1	+25 0
49	6	2·50	548	1	−19 29

TABLE II.—*continued.*

FOR ODD YEARS—(50-99).

Year.	Feriæ.	Tithi.	☽'s Anom.	Jul. Cal.	Solar Cor. *Â. S.* gh. p.
50	0	13·30	794	1	− 3 58
51	1	24·11	41	1	+11 34
52	2	4·91	287	1	+27 5
53	4	16·73	570	1	−17 24
54	5	27·53	816	1	− 1 53
55	6	8·33	63	1	+18 39
56	0	19·13	309	1	+29 10
57	2	0·95	592	1	−15 19
58	3	11·75	838	1	+ 0 12
59	4	22·55	85	1	+15 44
60	5	3·36	331	1	+31 15
61	0	15·17	614	1	−13 14
62	1	25·98	861	1	+ 2 17
63	2	6·78	107	1	+17 49
64	3	17·58	353	1	+33 20
65	5	29·40	636	1	−11 9
66	6	10·20	883	1	+ 4 12
67	0	21·00	129	1	+19 54
68	1	1·80	376	1	+35 25
69	3	13·62	658	1	− 9 4
70	4	24·42	905	1	+ 6 27
71	5	5·22	151	1	+21 59
72	0	17·04	434	2	−22 30
73	1	27·84	680	1	− 6 59
74	2	8·65	927	1	+ 8 32
75	3	19·45	173	1	+24 4
76	5	1·27	456	2	−20 25
77	6	12·07	702	1	− 4 54
78	0	22·87	949	1	+10 37
79	1	3·67	195	1	+26 9
80	3	15·49	478	2	−18 20
81	4	26·29	725	1	− 2 49
82	5	7·09	971	1	+12 42
83	6	17·90	217	1	+28 14
84	1	29·71	500	2	−16 15
85	2	10·52	747	1	− 0 44
86	3	21·32	993	1	+14 47
87	4	2·12	240	1	+30 19
88	6	13·94	522	2	−14 10
89	0	24·74	769	1	+ 1 21
90	1	5·54	15	1	+16 52
91	2	16·34	262	1	+32 24
92	4	28·16	544	2	−12 5
93	5	8·96	791	1	+ 3 26
94	6	19·77	37	1	+18 57
95	0	0·57	284	1	+34 29
96	2	12·39	566	2	−10 0
97	3	23·19	813	1	+ 5 31
98	4	3·99	59	1	+21 2
99	5	14·79	306	1	+36 34

[1] Year Kaliyuga = Vikrama + 3044 = Śaka + 3179 = A.D. + 3101.

TABLE III.—*For days of the year.*

Date.	0. Chaitra of preceding year. Solar Corr. Â. S. $-29^{gh.}\ 31^{p.}$ S. S. $-28\ 30$			1. Vaiśâkha (Mâdhava). $-8^{gh.}\ 53^{p.}$ $-10\ 14$			2. Jyaishṭha (Śukra). $-13^{gh.}\ 21^{p.}$ $-14\ 9$			3. Âshâḍha (Śuchi). $+10^{gh.}\ 51^{p.}$ $+11\ 7$			4. Śrâvaṇa (Nabhas). $-12^{gh.}\ 31^{p.}$ $-10\ 12$			5. Bhâdrapad (Nabhasya). $+15^{gh.}\ 41^{p.}$ $+17\ 57$			6. Âśvina (Isha). $+17^{gh.}\ 51^{p.}$ Â. S. $+19\ 20$ S. S.			Date.
	Fer.	Tithi.	☾'s An.	Fer.	Tithi.	☽'s An.	Fer.	Tithi.	☾'s An.	Fer.	Tithi.	☾'s An.	Fer.	Tithi.	☾'s An.	Fer.	Tithi.	☾'s An.	Fer.	Tithi.	☾'s An.	
0	2	26·49	802	4	26·96	891	0	28·49	16	3	0·06	141	0	2·66	303	3	4·24	428	6	5·78	553	0
1	3	27·50	839	5	27·97	927	1	29·50	52	4	1·07	177	1	3·68	339	4	5·26	464	0	6·80	589	1
2	4	28·52	875	6	28·99	964	2	0·52	89	5	2·09	214	2	4·70	375	5	6·28	500	1	7·82	625	2
3	5	29·53	912	0	0·00	0	3	1·54	125	6	3·11	250	3	5·72	411	6	7·29	536	2	8·83	661	3
4	6	0·55	948	1	1·02	36	4	2·56	161	0	4·13	286	4	6·74	448	0	8·31	573	3	9·85	698	4
5	0	1·56	984	2	2·04	73	5	3·58	198	1	5·15	323	5	7·76	484	1	9·33	609	4	10·87	734	5
6	1	2·58	20	3	3·06	109	6	4·59	234	2	6·17	359	6	8·77	520	2	10·35	645	5	11·88	770	6
7	2	3·59	56	4	4·07	145	0	5·61	270	3	7·19	395	0	9·79	557	3	11·36	682	6	12·90	807	7
8	3	4·61	92	5	5·09	181	1	6·63	306	4	8·21	432	1	10·81	593	4	12·38	718	0	13·91	843	8
9	4	5·62	129	6	6·10	218	2	7·65	343	5	9·23	468	2	11·83	629	5	13·40	754	1	14·93	879	9
10	5	6·64	165	0	7·12	254	3	8·67	379	6	10·24	504	3	12·85	665	6	14·42	790	2	15·95	916	10
11	6	7·65	202	1	8·14	290	4	9·68	415	0	11·26	540	4	13·87	702	0	15·44	827	3	16·96	952	11
12	0	8·67	238	2	9·16	327	5	10·70	452	1	12·28	577	5	14·89	738	1	16·45	863	4	17·98	988	12
13	1	9·68	272	3	10·17	363	6	11·72	488	2	13·30	613	6	15·91	774	2	17·47	899	5	19·00	24	13
14	2	10·70	310	4	11·19	399	0	12·74	524	3	14·32	649	0	16·92	811	3	18·49	936	6	20·01	61	14
15	3	11·71	347	5	12·21	436	1	13·76	561	4	15·34	686	1	17·94	847	4	19·51	972	0	21·03	97	15
16	4	12·73	383	6	13·22	472	2	14·78	597	5	16·36	722	2	18·96	883	5	20·53	8	1	22·04	133	16
17	5	13·75	419	0	14·24	508	3	15·80	633	6	17·38	758	3	19·98	919	6	21·54	45	2	23·06	170	17
18	6	14·76	455	1	15·26	544	4	16·81	669	0	18·40	794	4	21·00	956	0	22·56	81	3	24·08	206	18
19	0	15·78	492	2	16·28	581	5	17·83	706	1	19·41	831	5	22·02	992	1	23·58	117	4	25·09	242	19
20	1	16·79	528	3	17·29	617	6	18·85	742	2	20·43	867	6	23·04	28	2	24·59	153	5	26·11	278	20
21	2	17·81	564	4	18·31	653	0	19·87	778	3	21·45	903	0	24·05	65	3	25·61	190	6	27·12	315	21
22	3	18·83	601	5	19·33	690	1	20·89	815	4	22·47	940	1	25·07	101	4	26·63	226	0	28·14	351	22
23	4	19·84	637	6	20·34	726	2	21·91	851	5	23·49	976	2	26·09	137	5	27·65	262	1	29·16	387	23
24	5	20·86	673	0	21·36	762	3	22·93	887	6	24·51	12	3	27·11	174	6	28·66	299	2	0·17	424	24
25	6	21·87	710	1	22·38	798	4	23·94	923	0	25·53	48	4	28·13	210	0	29·68	335	3	1·19	460	25
26	0	22·89	746	2	23·40	835	5	24·96	960	1	26·55	85	5	29·15	246	1	0·70	371	4	2·20	496	26
27	1	23·90	782	3	24·41	871	6	25·98	996	2	27·57	121	6	0·16	282	2	1·71	407	5	3·22	532	27
28	2	24·92	819	4	25·43	907	0	27·00	32	3	28·59	157	0	1·18	319	3	2·73	444	6	4·23	569	28
29	3	25·94	855	5	26·45	944	1	28·02	69	4	29·60	194	1	2·20	355	4	3·75	480	0	5·25	605	29
30	...	...	...	6	27·47	980	2	29·04	105	5	0·62	230	2	3·22	391	5	4·77	516	1	6·26	641	30
31	...	...	...	...	...	..	...	...	...	6	1·64	266	...	...	...	...	...	...	...	...	...	31

Mîna. 0 = 16 Feb. C. Year. 0 = 27 Feb. L. Yr.	Mesha. = 14 *Mar.*	Vrisha 0 = 14 Apr.	Mithuna. 0 = 15 *May*	Karkaṭa. 0 = 16 June.	Siṁha. 0 = 17 *July.*	Kanyâ. 0 = 17 Aug.

Phâlguna of preceding year.			
Date.		Tithi.	An.
13	6	9·24	185
14	0	10·26	222
15	1	11·27	258
16	2	12·28	294
17	3	13·30	331
18	4	14·31	367
19	5	15·33	403
20	6	16·34	439
21	0	17·36	476
22	1	18·37	512
23	2	19·3	548
24	3	20·4	585
25	4	21·4	621
26	5	22·4	657
27	6	23·4	694
28	0	24·41	730
29	1	25·47	766

AUXILIARY TABLE III.

☾'s Equation of the centre: to be applied to the Tithi.

Argument: ☾'s Anom.		Eq. +	Argument: ☾'s Anom.		Eq. +	Argument: ☾'s Anom.		Eq. +	Argument: ☾'s Anom.		Eq. +
0 or	500	0·42	130 or	370	0·72	500 or	1,000	0·42	630 or	870	0·11
10	490	·44	140	360	·74	510	990	·39	640	860	·10
20	480	·47	150	350	·76	520	980	·37	650	850	·08
30	470	·50	160	340	·77	530	970	·34	660	840	·07
40	460	·52	170	330	·78	540	960	·31	670	830	·05
50	450	·55	180	320	·79	550	950	·28	680	820	·04
60	440	0·57	190	310	0·80	560	940	0·26	690	810	0·03
70	430	·59	200	300	·81	570	930	·24	700	800	·02
80	420	·62	210	290	·82	580	920	·22	710	790	·02
90	410	·64	220	280	·83	590	910	·19	720	780	·01
100	400	·66	230	270	·83	600	900	·17	730	770	·00
110	390	·68	240 or	260	·83	610	890	·15	740 or	760	·00
120 or	380	0·70	250		0·83	620 or	880	0·13	750		0·00

TABLE III—*continued.*

	7. Kârttika (Ûrja). Sol. Corr. Â.S.-14gh. 47p. S.S.-14 7			8. Mârgaśira (Sahas). -20gh. 40p. -20 34			9. Pausha (Sahasya). +9gh. 44p. +8 55			10. Mâgha (Tapas). +30gh. 37p. +28 0			11. Phâlgun (Tapasya). -1gh. 7p. -5 8			12. Chaitra (Madhu). -13gh. 4p. -15 53			13. Vaiśâkha of following year. +5gh. 20p. Â. S. +6 38 S. S.			
Date.	Fer.	Tithi.	☾'s An.	Fer.	Tithi.	☾'s An.	Fer.	Tithi.	☾'s An.	Fer.	Tithi.	☾'s An.	Fer.	Tithi.	☾'s An.	Fer.	Tithi.	☾'s An.	Fer.	Tithi.	☾'s An.	Date.
0	2	7·28	678	4	7·71	766	5	7·10	819	6	6·47	871	1	6·86	960	3	7·29	49	5	7·75	138	0
1	3	8·29	714	5	8·73	803	6	8·11	855	0	7·48	908	2	7·88	996	4	8·31	85	6	8·77	174	1
2	4	9·31	750	6	9·74	839	0	9·12	891	1	8·50	944	3	8·89	33	5	9·32	121	0	9·79	210	2
3	5	10·32	787	0	10·75	875	1	10·14	928	2	9·51	980	4	9·90	69	6	10·33	158	1	10·80	246	3
4	6	11·33	823	1	11·77	912	2	11·15	964	3	10·52	16	5	10·92	105	0	11·35	194	2	11·82	283	4
5	0	12·35	859	2	12·78	948	3	12·16	0	4	11·53	53	6	11·93	142	1	12·36	230	3	12·84	319	5
6	1	13·37	895	3	13·79	984	4	13·18	37	5	12·55	89	0	12·95	178	2	13·38	267	4	13·85	355	6
7	2	14·39	932	4	14·81	20	5	14·19	73	6	13·56	125	1	13·96	214	3	14·39	303	5	14·87	391	7
8	3	15·40	968	5	15·82	57	6	15·20	109	0	14·57	162	2	14·97	250	4	15·41	339	6	15·89	428	8
9	4	16·42	4	6	16·83	93	0	16·21	145	1	15·59	198	3	15·99	287	5	16·42	375	0	16·90	464	9
10	5	17·43	41	0	17·85	129	1	17·23	182	2	16·60	234	4	17·00	323	6	17·44	412	1	17·92	500	10
11	6	18·44	77	1	18·86	166	2	18·24	218	3	17·61	271	5	18·01	359	0	18·45	448	2	18·94	537	11
12	0	19·46	113	2	19·87	202	3	19·25	254	4	18·63	307	6	19·03	396	1	19·47	484	3	19·95	573	12
13	1	20·47	149	3	20·89	238	4	20·26	291	5	19·64	343	0	20·04	432	2	20·49	521	4	20·97	609	13
14	2	21·49	186	4	21·90	274	5	21·28	327	6	20·65	379	1	21·06	468	3	21·50	557	5	21·99	645	14
15	3	22·50	222	5	22·91	311	6	22·29	363	0	21·67	416	2	22·07	504	4	22·52	593	6	23·01	682	15
16	4	23·51	258	6	23·93	347	0	23·30	400	1	22·68	452	3	23·09	541	5	23·53	629	0	24·02	718	16
17	5	24·53	295	0	24·94	383	1	24·32	436	2	23·69	488	4	24·10	577	6	24·55	666	1	25·04	754	17
18	6	25·54	331	1	25·95	420	2	25·33	472	3	24·71	525	5	25·12	613	0	25·56	702	2	26·06	791	18
19	0	26·56	367	2	26·97	456	3	26·34	508	4	25·72	561	6	26·13	650	1	26·58	738	3	27·08	827	19
20	1	27·57	403	3	27·98	492	4	27·36	545	5	26·73	597	0	27·14	686	2	27·59	775	4	28·09	863	20
21	2	28·59	440	4	28·99	529	5	28·37	581	6	27·75	633	1	28·16	722	3	28·61	811	5	29·11	900	21
22	3	29·60	476	5	0·01	565	6	29·38	617	0	28·76	670	2	29·17	758	4	29·63	847	6	0·13	936	22
23	4	0·61	512	6	1·02	601	0	0·39	654	1	29·77	706	3	0·19	795	5	0·64	884	0	1·14	972	23
24	5	1·63	549	0	2·03	637	1	1·41	690	2	0·78	742	4	1·20	831	6	1·66	920	1	2·16	9	24
25	6	2·64	585	1	3·05	674	2	2·42	726	3	1·80	779	5	2·21	867	0	2·67	956	2	3·18	45	25
26	0	3·66	621	2	4·06	710	3	3·43	762	4	2·81	815	6	3·23	904	1	3·69	992	3	4·20	81	26
27	1	4·67	658	3	5·07	746	4	4·45	799	5	3·82	851	0	4·24	940	2	4·71	29	4	5·21	117	27
28	2	5·68	694	4	6·09	783	5	5·46	835	6	4·84	887	1	5·26	976	3	5·72	65	5	6·23	154	28
29	3	6·70	730	...	...	...	...	...	...	0	5·85	924	2	6·27	13	4	6·74	101	6	7·25	190	29
30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	8·27	226	30
	Tulâ Saṁk. 0=17 Sept.			Vṛiśchika. 0=17 *Oct.*			Dhanuḥ. 0=15 Nov.			Makara. 0=14 *Dec.*			Kumbha. 0=13 *Jan.*			Mîna. 0=12 Feb.			Mesha. 0=14 *Mar.* C. Yr. 0=13 *Mar.* L. Yr.			

TABLE IV.

Increase of tithi and moon's anomaly in Ghaṭikâs.

Gh.	Tithi.	An.	Gh.	Tithi.	An.	Gh.	Tithi.	An.	Gh.	Tithi.	An.
1	0·02	1	16	0·27	10	31	0·52	19	46	0·78	28
2	0·03	1	17	0·29	10	32	0·54	19	47	0·80	28
3	0·05	2	18	0·30	11	33	0·56	20	48	0·81	29
4	0·07	2	19	0·32	11	34	0·57	21	49	0·83	30
5	0·08	3	20	0·34	12	35	0·59	21	50	0·85	30
6	0·10	4	21	0·36	13	36	0·61	22	51	0·86	31
7	0·12	4	22	0·37	13	37	0·63	22	52	0·88	31
8	0·14	5	23	0·39	14	38	0·64	23	53	0·89	32
9	0·15	5	24	0·41	15	39	0·66	24	54	0·91	33
10	0·17	6	25	0·42	15	40	0·68	24	55	0·93	33
11	0·19	7	26	0·44	16	41	0·69	25	56	0·95	34
12	0·20	7	27	0·46	16	42	0·71	25	57	0·96	34
13	0·22	8	28	0·47	17	43	0·73	26	58	0·98	35
14	0·24	8	29	0·49	18	44	0·74	27	59	1·00	36
15	0·25	9	30	0·51	18	45	0·76	27	60	1·02	36

TABLE V.

Ending points of Zodiacal Signs.

Râśi.	End.
Mesha	30°
Vṛisha	60°
Mithuna	90°
Karkaṭa	120°
Siṁha	150°
Kanyâ	180°
Tulâ	210°
Vṛiśchika	240°
Dhanuḥ	270°
Makara	300°
Kumbha	330°
Mîna	360°

TABLE VI.—*For Centuries of the Kaliyuga.*

Cent. K. Y.	Ahargaṇa.	Sun from the Moon's Node. Mod.	Árya.	Sûrya Siddh. Text.	Sûrya Siddh. With Bîja.	Brah.	Śiro.	Jupiter's Saṁvat. S. S.[1]
3000	1095 776	511	From 3700 Lalla's corrections are applied.	...	...	...	...	35·10
3100	1132 302	268		...	...	...	...	16·27
3200	1168 828	23		...	...	...	...	57·41
3300	1205 354	778		...	...	...	...	38·61
3400	1241 880	535		...	...	...	...	19·78
3500	1278 405	284		...	...	...	...	0·95
3600	1314 931	40	42	...	...	...	...	42·12
3700	1351 457	796	798	...	...	796	...	23·29
3800	1387 983	551	553	...		552	...	4·46
3900	1424 509	307	309	...	...	307	...	45·63
4000	1461 035	62	64	...	...	64	...	26·80
4100	1497 561	819	820	824	...	820	818	7·97
4200	1534 087	573	575	577	...	576	574	49·14
4300	1570 612	323	325	323	...	326	324	30·31
4400	1607 138	79	81	76	...	82	80	11·48
4500	1643 664	834	836	828	...	838	836	52·65
4600	1680 190	590	592	580	587	588	592	33·82
4700	1716 716	345	347	333	343	350	348	14·99
4800	1753 242	100	103	86	98	106	104	56·16
4900	1789 768	856	858	838	852	862	860	37·33
5000	1826 293	605	608	590	601	612	610	18·50

TABLE VII.—*For years of a Century.*

Yr.	Aharg.	☉ from Node.	Jupiter's Saṁvat.	Yr.	Aharg.	☉ from Node.	Jupiter's Saṁvat.[1]
0	0	0	0·	25	9 131	686	25·2925
1	365	106	1·0117	26	9 497	798	26·3042
2	730	212	2·0234	27	9 862	904	27·3159
3	1 096	324	3·0351	28	10 227	10	28·3276
4	1 461	430	4·0468	29	10 592	116	29·3393
5	1 826	526	5·0585	30	10 958	228	30·3510
6	2 191	642	6·0702	31	11 323	334	31·3627
7	2 557	754	7·0819	32	11 688	440	32·3744
8	2 922	861	8·0936	33	12 053	546	33·3861
9	3 287	966	9·1053	34	12 419	658	34·3978
10	3 652	72	10·1170	35	12 784	764	35·4095
11	4 018	184	11·1287	36	13 149	870	36·4212
12	4 383	290	12·1404	37	13 514	976	37·4329
13	4 748	396	13·1521	38	13 880	88	38·4446
14	5 114	508	14·1638	39	14 245	194	39·4563
15	5 479	614	15·1755	40	14 610	300	40·4680
16	5 844	720	16·1872	41	14 975	406	41·4797
17	6 209	826	17·1989	42	15 341	518	42·4914
18	6 575	938	18·2106	43	15 706	624	43·5031
19	6 940	44	19·2223	44	16 071	730	44·5148
20	7 305	150	20·2340	45	16 437	842	45·5265
21	7 670	256	21·2457	46	16 802	948	46·5382
22	8 036	268	22·2574	47	17 167	54	47·5499
23	8 401	474	23·2691	48	17 532	160	48·5616
24	8 766	580	24·2808	49	17 898	272	49·5733

TABLE VII.—*continued.*

Yr.	Aharg.	☉ from Node.	Jupiter's Saṁvat.[1]
50	18 263	378	50·5850
51	18 628	484	51·5967
52	18 993	590	52·6084
53	19 359	702	53·6201
54	19 724	808	54·6318
55	20 089	914	55·6435
56	20 454	20	56·6552
57	20 820	132	57·6669
58	21 185	238	58·6786
59	21 550	344	59·6903
60	21 915	450	0·7020
61	22 281	562	1·7137
62	22 646	668	2·7254
63	23 011	774	3·7371
64	23 376	880	4·7488
65	23 742	992	5·7605
66	24 107	98	6·7722
67	24 472	204	7·7839
68	24 837	310	8·7956
69	25 203	422	9·8073
70	25 568	528	10·8190
71	25 933	634	11·8307
72	26 299	746	12·8424
73	26 664	852	13·8541
74	27 029	958	14·8658
75	27 394	64	15·8775
76	27 760	176	16·8892
77	28 125	282	17·9009
78	28 490	388	18·9126
79	28 855	494	19·9243
80	29 221	606	20·9360
81	29 586	712	21·9477
82	29 951	818	22·9594
83	30 316	924	23·9711
84	30 682	36	24·9828
85	31 047	172	25·9945
86	31 412	248	27·0062
87	31 777	354	28·0179
88	32 143	466	29·0296
89	32 508	572	30·0413
90	32 873	678	31·0530
91	33 238	784	32·0647
92	33 604	896	33·0764
93	33 969	2	34·0881
94	34 334	108	35·0998
95	34 699	214	36·1115
96	35 065	326	37·1232
97	35 430	432	38·1349
98	35 795	538	39·1466
99	36 160	644	40·1583

[1] These values are those of the *Sûrya Siddhânta* with the *bîja* or correction, *viz.* for 364,212 revolutions in a *yuga*. For this value without *bîja* (364,220 rev.) multiply the year K. Y. by 2 and divide by 90,000, and deduct the result from the tabular value; or the *Ârya Siddhânta* value (364,224 rev.), divide the year K. Y. by 30,000, and deduct the fraction from the tabular value.

TABLE VIII.—*For months and days.*

Day.	CHAITRA OF PRECEDING YEAR. Ah.	N.	⊙'s long.	Jup.	II. JYAISHṬHA. Ah.	N.	⊙'s long.	Jup.	IV. ŚRÂVAṆA. Ah.	N.	⊙'s long.	Jup.	Day.
0	33	799	329° 29′	59·9086	28	152	29° 10′	0·0776	91	527	89° 15′	0·2521	0
1	32	804	330° 29′	59·9114	29	157	30° 13′	0·0803	92	533	90° 12′	0·2548	1
2	31	810	331° 29′	59·9141	30	163	31° 11′	0·0831	93	539	91° 9′	0·2576	2
3	30	816	332° 29′	59·9169	31	170	32° 8′	0·0859	94	544	92° 6′	0·2604	3
4	29	822	333° 29′	59·9197	32	176	33° 6′	0·0886	95	550	93° 3′	0·2631	4
5	28	827	334° 28′	59·9224	33	181	34° 3′	0·0914	96	556	94° 0′	0·2659	5
6	27	833	335° 28′	59·9252	34	187	35° 1′	0·0942	97	562	94° 57′	0·2687	6
7	26	839	336° 28′	59·9280	35	193	35° 58′	0·0969	98	568	95° 54′	0·2715	7
8	25	844	337° 27′	59·9308	36	199	36° 56′	0·0997	99	574	96° 52′	0·2742	8
9	24	850	338° 27′	59·9335	37	204	37° 54′	0·1023	100	580	97° 48′	0·2770	9
10	23	855	339° 26′	59·9363	38	210	38° 51′	0·1053	101	587	98° 45′	0·2798	10
11	22	861	340° 26′	59·9391	39	217	39° 48′	0·1080	102	593	99° 42′	0·2825	11
12	21	867	341° 25′	59·9418	40	223	40° 46′	0·1108	103	598	100° 39′	0·2853	12
13	20	873	342° 25′	59·9446	41	229	41° 43′	0·1136	104	604	101° 36′	0·2881	13
14	19	878	343° 25′	59·9474	42	234	42° 40′	0·1163	105	610	102° 33′	0·2909	14
15	18	884	344° 24′	59·9501	43	240	43° 38′	0·1191	106	616	103° 30′	0·2936	15
16	17	890	345° 24′	59·9529	44	246	44° 35′	0·1219	107	622	104° 27′	0·2964	16
17	16	896	346° 23′	59·9557	45	252	45° 32′	0·1246	108	628	105° 25′	0·2992	17
18	15	901	347° 22′	59·9585	46	258	46° 30′	0·1274	109	634	106° 22′	0·3019	18
19	14	907	348° 21′	59·9612	47	264	47° 27′	0·1302	110	640	107° 19′	0·3047	19
20	13	913	349° 20′	59·9640	48	270	48° 24′	0·1330	111	646	108° 17′	0·3074	20
21	12	919	350° 19′	59·9668	49	276	49° 21′	0·1357	112	652	109° 14′	0·3102	21
22	11	925	351° 18′	59·9694	50	282	50° 18′	0·1385	113	658	110° 12′	0·3130	22
23	10	930	352° 17′	59·9723	51	288	51° 15′	0·1413	114	664	111° 9′	0·3158	23
24	9	936	353° 16′	59·9751	52	294	52° 13′	0·1440	115	670	112° 6′	0·3185	24
25	8	942	354° 15′	59·9778	53	300	53° 10′	0·1468	116	676	113° 4′	0·3213	25
26	7	948	355° 14′	59·9806	54	306	54° 6′	0·1496	117	682	114° 1′	0·3241	26
27	6	853	356° 13′	59·9834	55	312	55° 3′	0·1523	118	688	114° 58′	0·3269	27
28	5	959	357° 12′	59·9862	56	318	56° 1′	0·1551	119	694	115° 56′	0·3296	28
29	4	965	358° 11′	59·9889	57	324	56° 57′	0·1579	120	699	116° 43′	0·3324	29
30					58	330	57° 55′	0·1607	121	705	117° 50′	0·3352	30
	I. VAIŚÂKHA.				III. ÂSHÂḌHA.				V. BHÂDRAPADA.				
0	3	971	359° 10′	59·9917	59	335	58° 51′	0·1634	122	712	118° 48′	0·3379	0
1	2	976	0° 9′	59·9944	60	341	59° 50′	0·1662	123	718	119° 45′	0·3407	1
2	1	982	1° 8′	59·9972	61	348	60° 47′	0·1690	124	723	120° 42′	0·3435	2
3	0	988	2° 6′	0·0000	62	354	61° 44′	0·1717	125	729	121° 40′	0·3462	3
4	1	994	3° 5′	0·0028	63	360	62° 41′	0·1745	126	735	122° 37′	0·3490	4
5	2	0	4° 3′	0·0056	64	365	63° 38′	0·1773	127	741	123° 35′	0·3518	5
6	3	5	5° 2′	0·0083	65	371	64° 35′	0·1800	128	747	124° 33′	0·3546	6
7	4	11	6° 0′	0·0111	66	377	65° 32′	0·1828	129	752	125° 30′	0·3573	7
8	5	17	6° 59′	0·0138	67	383	66° 30′	0·1856	130	758	126° 28′	0·3601	8
9	6	23	7° 57′	0·0166	68	389	67° 26′	0·1884	131	765	127° 26′	0·3629	9
10	7	28	8° 56′	0·0194	69	395	68° 23′	0·1911	132	771	128° 24′	0·3656	10
11	8	34	9° 54′	0·0222	70	401	69° 20′	0·1939	133	776	129° 22′	0·3684	11
12	9	40	10° 51′	0·0249	71	407	70° 17′	0·1967	134	782	130° 20′	0·3712	12
13	10	46	11° 49′	0·0277	72	413	71° 14′	0·1994	135	788	131° 17′	0·3739	13
14	11	52	12° 48′	0·0305	73	419	72° 11′	0·2022	136	794	132° 15′	0·3767	14
15	12	57	13° 46′	0·0332	74	425	73° 8′	0·2050	137	800	133° 13′	0·3795	15
16	13	64	14° 44′	0·0360	75	431	74° 4′	0·2077	138	806	134° 11′	0·3823	16
17	14	70	15° 42′	0·0388	76	437	75° 1′	0·2105	139	812	135° 10′	0·3850	17
18	15	76	16° 40′	0·0416	77	443	75° 58′	0·2133	140	818	136° 8′	0·3878	18
19	16	81	17° 37′	0·0443	78	449	76° 55′	0·2160	141	824	137° 6′	0·3906	19
20	17	87	18° 35′	0·0471	79	455	77° 52′	0·2188	142	829	138° 4′	0·3933	20
21	18	93	19° 33′	0·0499	80	461	78° 49′	0·2216	143	835	139° 2′	0·3961	21
22	19	99	20° 31′	0·0526	81	467	79° 46′	0·2244	144	841	140° 0′	0·3989	22
23	20	104	21° 29′	0·0554	82	473	80° 43′	0·2271	145	847	140° 58′	0·4016	23
24	21	110	22° 27′	0·0582	83	479	81° 40′	0·2299	146	852	141° 56′	0·4044	24
25	22	116	23° 25′	0·0609	84	485	82° 37′	0·2327	147	859	142° 55′	0·4072	25
26	23	122	24° 22′	0·0637	85	491	83° 34′	0·2354	148	865	143° 53′	0·4100	26
27	24	128	25° 19′	0·0665	86	497	84° 31′	0·2382	149	871	144° 52′	0·4127	27
28	25	134	26° 17′	0·0693	87	503	85° 28′	0·2410	150	876	145° 50′	0·4155	28
29	26	140	27° 14′	0·0720	88	509	86° 24′	0·2438	151	882	146° 48′	0·4183	29
30	27	146	28° 12′	0·0748	89	515	87° 21′	0·2465	152	888	147° 47′	0·4210	30
31					90	520	88° 18′	0·2493					31

TABLE VIII—continued.

	VI. Âśvina.				VIII. Mârgaśira.				X. Mâgha.				XII. Chaitra.				
Day.	Ah.	N.	☉'s long.	Jup.	Ah.	N.	☉'s long.	Jup.	Ah.	N.	☉'s long	Jup.	Ah.	N.	☉'s long.	Jup.	Day.
0	153	894	148° 45′	0·4238	214	244	209° 20	0 5928	272	568	268° 29′	0·7534	332	905	329° 13′	0·9196	0
1	154	900	149° 43′	0·4266	215	250	210° 21′	0·5955	273	573	269° 30′	0·7562	333	910	330° 13′	0·9224	1
2	155	905	150° 41′	0·4293	216	255	211° 22′	0·5983	274	579	270° 31′	0·7590	334	916	331° 13′	0·9252	2
3	156	911	151° 40′	0·4321	217	261	212° 23′	0·6011	275	585	271° 33′	0·7617	335	922	332° 13′	0·9279	3
4	157	917	152° 38′	0·4349	218	267	213° 23′	0 6039	276	591	272° 34′	0 7645	336	927	333° 13′	0·9307	4
5	158	923	153° 37′	0·4377	219	272	214° 24′	0·6063	277	596	273° 36′	0·7673	337	933	334° 12′	0·9335	5
6	159	928	154° 36′	0·4404	220	277	215° 25′	0·6094	278	601	274° 37′	0·7701	338	939	335° 12′	0·9363	6
7	160	934	155° 34′	0·4432	221	283	216° 26′	0·6122	279	607	275° 38′	0·7728	339	945	336° 12′	0·9390	7
8	161	941	156° 33′	0·4460	222	289	217° 27′	0·6149	280	613	276° 39′	0·7756	340	950	337° 11′	0·9418	8
9	162	947	157° 31′	0·4487	223	295	218° 28′	0·6177	281	618	277° 41′	0·7784	341	956	338° 11′	0·9446	9
10	163	953	158° 30′	0·4515	224	300	219° 29′	0·6205	282	624	278° 42′	0·7811	342	961	339° 11′	0·9473	10
11	164	958	159° 29′	0·4543	225	306	220° 30′	0·6232	283	629	279° 43′	0·7839	343	967	340° 11′	0·9501	11
12	165	964	160° 28′	0·4570	226	312	221° 31′	0·6260	284	634	280° 44′	0·7867	344	973	341° 10′	0·9529	12
13	166	970	161° 27′	0·4598	227	318	222° 32′	0·6288	285	640	281° 46′	0·7894	345	979	342° 10′	0·9556	13
14	167	976	162° 26′	0 4626	228	323	223° 33′	0·6316	286	646	282° 47′	0·7922	346	984	343° 9′	0·9584	14
15	168	981	163° 25′	0·4654	229	328	224° 35′	0·6343	287	652	283 48′	0·7950	347	990	344° 8′	0·9612	15
16	169	987	164° 24′	0·4681	230	334	225° 36′	0·6371	288	657	284° 49′	0·7978	348	996	345° 8′	0·9640	16
17	170	993	165° 23′	0·4709	231	340	226° 37′	0 6399	289	663	285° 50′	0·8005	349	2	346° 7′	0·9667	17
18	171	999	166° 22′	0·4737	232	346	227° 38′	0·6426	290	668	286° 51′	0·8033	350	7	347° 6′	0·9695	18
19	172	4	167° 21′	0·4764	233	351	228° 39′	0·6454	291	674	287° 52′	0·8061	351	13	348° 6′	0 9723	19
20	173	10	168° 20′	0·4792	234	356	229° 40′	0·6482	292	680	288° 53′	0·8088	352	19	349° 5′	0 9750	20
21	174	16	169° 19′	0·4820	235	362	230° 41′	0·6509	293	685	289° 54′	0·8116	353	25	350° 4′	0·9778	21
22	175	22	170° 19′	0·4847	236	368	231° 42′	0·6537	294	690	290° 55′	0·8144	354	31	351° 3′	0·9806	22
23	176	28	171° 18′	0·4875	237	373	232° 43′	0·6565	295	696	291° 56′	0·8171	355	36	352° 2′	0·9833	23
24	177	33	172° 18′	0·4903	238	378	233° 44′	0·6593	296	702	292° 57′	0·8199	356	42	353° 1′	0·9861	24
25	178	39	173° 17′	0·4931	239	384	234° 45′	0·6620	297	708	293° 58′	0·8227	357	48	354° 0′	0·9889	25
26	179	45	174° 16′	0·4958	240	390	235° 46′	0·6648	298	712	294° 59′	0 8255	358	54	354° 59′	0·9917	26
27	180	51	175° 16′	0·4986	241	396	236° 47′	0·6676	299	718	296° 0′	0·8282	359	59	355° 58′	0·9944	27
28	181	56	176° 16′	0·5014	242	401	237° 49′	0·6703	300	724	297° 1′	0·8310	360	65	356° 57	0·9972	28
29	182	62	177° 15′	0·5041					301	730	298° 2′	0·8338	361	71	357° 56′	1·0000	29
30	183	68	178° 15′	0·5069													
	VII. Kârttika.				IX. Pausha.				XI. Phâlguna.				XIII. Vaiśâkha of the following year.				
0	184	74	179° 15′	0·5097	243	406	238° 50′	0·6731	302	736	299° 3′	0·8365	362	77	358° 55′	1·0027	0
1	185	79	180° 15′	0·5124	244	412	239° 51′	0·6759	303	741	300° 2′	0·8393	363	83	359° 54′	1·0055	1
2	186	85	181° 15′	0·5152	245	418	240° 52′	0·6786	304	746	301° 3′	0·8421	364	88	0° 53′	1·0083	2
3	187	90	182° 15′	0·5180	246	423	241° 54′	0·6814	305	752	302° 4′	0·8448	365	94	1° 51′	1·0110	3
4	188	96	183° 14′	0·5208	247	429	242° 55′	0·6842	306	758	303° 5′	0·8476	366	100	2° 50′	1·0138	4
5	189	102	184° 14′	0·5235	248	434	243° 57′	0·687	307	763	304° 5′	0·8504	367	106	3° 48′	1·0166	5
6	190	107	185° 14′	0·5263	249	440	244° 58′	0·6897	308	769	305° 6′	0·8532	368	111	4° 47′	1·0194	6
7	191	113	186° 14′	0·5291	250	445	245° 59′	0·6925	309	775	306° 7′	0·8559	369	117	5° 45′	1 0221	7
8	192	119	187° 14′	0·5318	251	451	247° 1′	0·6953	310	781	307° 7′	0·8587	370	123	6° 44′	1·0249	8
9	193	125	188° 14′	0·5346	252	457	248° 2′	0·698	311	786	308° 8′	0·8615	371	129	7° 42′	1·0277	9
10	194	130	189° 14′	0·5374	253	463	249° 4′	0·7008	312	791	309° 9′	0·8642	372	134	8° 41′	1·0304	10
11	195	136	190° 14′	0·5401	254	468	250° 5′	0·7036	313	797	310° 9′	0·8670	373	140	9° 39′	1·0332	11
12	196	142	191° 14′	0·5429	255	473	251° 7′	0·7063	314	803	311° 10′	0·8698	374	146	10° 37′	1·0360	12
13	197	148	192° 14′	0·5457	256	479	252° 8′	0·7091	315	809	312° 10′	0·8725	375	152	11° 35′	1·0387	13
14	198	153	193° 14′	0·5485	257	485	253° 9′	0·7119	316	814	313° 10′	0·8753	376	158	12° 33′	1·0415	14
15	199	159	194° 14′	0·5512	258	490	254° 10′	0·7147	317	820	314° 10′	0·8781	377	164	13° 31′	1·0443	15
16	200	165	195° 14′	0·5540	259	495	255° 11′	0·7174	318	826	315° 11′	0 8809	378	170	14° 29′	1 0471	16
17	201	171	196° 14′	0·5568	260	501	256° 13′	0·7202	319	831	316° 11′	0·8836	379	176	15° 27′	1·0498	17
18	202	176	197° 14′	0·5595	261	507	257° 14′	0·7230	320	836	317° 11′	0·8864	380	181	16° 25′	1 0526	18
19	203	181	198° 14′	0·5623	262	513	258° 15′	[illegible]	321	842	318° 12′	0·8892	381	187	17° 23′	1·0554	19
20	204	187	199° 15′	0·5651	263	518	259° 17′	0·7285	322	848	319° 12′	0·8919	382	193	18° 21′	1·0581	20
21	205	193	200° 15′	0·5678	264	523	260° 18′	0·7313	323	854	320° 12′	0·8947	383	199	19° 19′	1·0609	21
22	206	199	201° 15′	0·5706	265	529	261° 20′	0·7340	324	859	321° 12′	0·8975	384	204	20° 17′	1·0637	22
23	207	204	202° 16′	0·5734	266	535	262° 21′	0·7368	325	865	322° 12	0·9002	385	210	21° 15′	1·0664	23
24	208	210	203° 16′	0·5762	267	540	263° 22′	0·7396	326	871	323° 12′	0·9030	386	216	22° 13′	1·0692	24
25	209	216	204° 17′	0·5789	268	545	264° 24′	0·7424	327	877	324° 13′	0·9058	387	222	23° 11′	1·0720	25
26	210	222	205° 17′	0·5817	269	551	265° 25′	0·7451	328	882	325° 13′	0·9086	388	228	24° 9′	1·0748	26
27	211	227	206° 18′	0·5844	270	557	266° 27′	0·7479	329	887	326° 13′	0·9113	389	234	25° 6′	1·0775	27
28	212	233	207° 19′	0·5872	271	563	267° 28′	0·7507	330	893	327° 13′	0·9141	390	240	26° 3′	1·0803	28
29	213	238	208° 20′	0·5900					331	899	328° 13′	0·9169	391	246	27° 1′	1·0831	29
30													392	252	27° 59′	1·0858	30

TABLE IX.—*For Nakshatras and Yogas.*

No.	Nakshatra.	Index.	Yoga.
1	Aśvinî	0° 0′ — 13° 20′	Vishkambha.
2	Bharinî*	13° 20′ — 26° 40′	Prîti.
3	Krittikâ	26° 40′ — 40° 0′	Ayushmat.
4	Rohinî*	40° 0′ — 53° 20′	Saubhâgya.
5	Mrigaśiras	53° 20′ — 56° 40′	Śobhana.
6	Ardrâ*	66° 40′ — 80° 0′	Atiganda.
7	Punarvasu	80° 0′ — 93° 20′	Sukarman.
8	Pushya*	93° 20′ — 106° 40′	Dhriti.
9	Aśleshâ	106° 40′ — 120° 0′	Śûla.
10	Maghâ*	120° 0′ — 133° 20′	Ganda.
11	Pûrva-Phalgunî	133° 20′ — 146° 40′	Vriddhi.
12	Uttara-Phalgunî	146° 40′ — 160° 0′	Dhruva.
13	Hastâ*	160° 0′ — 173° 20′	Vyâghâta.
14	Chitrâ	173° 20′ — 186° 40′	Harshana.
15	Svâti*	186° 40′ — 200° 0′	Vajra.
16	Viśâkhâ	200° 0′ — 213° 20′	Siddhi.
17	Anurâdhâ*	213° 20′ — 226° 40′	Vyatîpâta.
18	Jyeshthâ	226° 40′ — 240° 0′	Varîyas.
19	Mûla*	240° 0′ — 253° 20′	Parigha.
20	Pûrva-Ashâdhâ	253° 20′ — 266° 40′	Śiva.
21	Uttara-Ashâdhâ*	266° 40′ — 280° 0′	Siddha.
22	Śravana[1]	280° 0′ — 293° 20′	Sâdhya.
23	Śravishthâ or Dhanishthâ*	293° 20′ — 306° 40′	Śubha.
24	Śatabhishaj or Śatatâraka	306° 40′ — 320° 0′	Śukla.
25	Pûrva-Bhadrapadâ	320° 0′ — 333° 20′	Brahman.
26	Uttara-Bhadrapadâ*	333° 20′ — 346° 40′	Indra.
27	Revatî	346° 40′ — 360° 0′	Vaidhriti.

TABLE XI.—*For difference of Nakshatras and Yogas.*

Nakshatra.	Δ	Yoga.
gh. p.		gh. p.
0 46	10′	0 42
1 31	20′	1 25
2 17	30′	2 7
3 2	40′	2 49
3 48	50′	3 32
4 33	1°	4 14
9 7	2°	8 28
13 40	3°	12 42
18 13	4°	16 56
22 47	5°	21 10
27 20	6°	25 25
31 53	7°	29 39
36 26	8°	33 53
41 0	9°	38 7
45 33	10°	42 21
50 7	11°	46 35
54 40	12°	50 49
59 13	13°	55 3
60 44	13° 20′	56 28

TABLE X.—*Ending points of the Nakshatras according to Garga and the Brahma Siddhánta and the presiding Divinities of the Nakshatras.*

No.	Garga.	Brahma.	Deity.
1	13° 20′	13° 10′ 35″	Aśvin.
2	20° 0′	19° 45′ 32	Yama.
3	33° 20′	32° 56′ 27	Agni.
4	53° 20′	52° 42′ 20	Prajâpati.[2]
5	66° 40′	65° 52′ 55	Soma.
6	73° 20′	72° 28′ 12	Rudra.
7	93° 20′	92° 14′ 5	Aditi.
8	106° 40′	105° 24′ 40	Brihaspati.
9	113° 20′	111° 59′ 57	Sarpâh.
10	126° 40′	125° 10′ 32	Pitarah.
11	140° 0′	138° 21′ 7	Bhaga &
12	160° 0′	158° 7′ 0	Aryaman.
13	173° 20′	171° 17′ 35	Savitri.
14	186° 40′	18° 28′ 10	Tvashtri.
15	193° 20′	191° 3′ 27	Vâyu.
16	213° 20′	210° 49′ 20	Indrâgnî.
17	226° 40′	223° 59′ 55	Mitra.
18	233° 20′	230° 35′ 12	Indra.
19	246° 40′	243° 45′ 47	Nirriti.
20	260° 0′	256° 56′ 22	Âpah.
21	280° 0′	276° 42′ 15	Viśvedevâh.
Abhijit		280° 56′ 30	Brahma.
22	293° 20′	294° 7′ 5	Vishnu.
23	306° 40′	307° 17′ 40	Vasavah.
24	313° 20′	313° 52′ 57	Varuna.
25	326° 40′	327° 3′ 32	Aja Ekapâd.
26	346° 40′	346° 49′ 25	Ahi Budhnya.
27	360° 0′	360° 0′ 0	Pûshan.

[1] The Nakshatra Abhijit is sometimes inserted between Nos. 21 and 22; its extent is 276° 40′ — 281° 40′.

[2] According to the *Muhûrtachintâmani* the deity of 4 is Brahma, of 8 Prajâpati, and Abhijit is omitted.

TABLE XII.—*Equation of Jupiter's true to his mean place, at or near conjunction.*

Arg.[3] (§ 48)	Eq.	Arg.[3] (§ 48)
2·73	0·14	8·73
2·40 or 3·06	0·14	8·40 or 9·06
2·06 3·40	0·13	8·06 9·40
1·73 3·73	0·12	7·73 9·73
1·40 4·06	0·11	7·40 10·06
1·06 4·40	0·09	7·06 10·40
0·73 4·73	0·07	6·73 10·73
0·40 5·06	0·05	6·40 11·06
0·06 5·40	0·03	6·06 11·40
11·73 5·73	0·00	5·73 11·73

[3] If the equation falls in the left side, the equation is additive; if in the ~~left~~ right, it is subtractive.

SPECIAL TABLES.

TABLE XIII.—*Sun and moon's places for centuries.*

SÛRYA SIDDHÂNTA.

Cent. K. Y.	Dist. ☾ − ⊙	☾'s Anomaly. Uncorrected.	☾'s Anomaly. *With Bîja.*	⊙'s Anom.	Cor.
					gh. p.
3000	174° 0′	73° 17′ 0″	...	282° 46′ 24″	— 1 10
3100	131 48	282 43 30	...	282 46 12	+ 6 18
3200	89 36	132 10 0	...	282 46 0	+13 46
3300	47 24	341 36 30	...	282 45 49	+21 13
3400	5 12	191 3 0	...	282 45 37	+28 41
3500	323 0	40 29 30	...	282 45 25	—23 52
3600	280 48	249 56 0	...	282 45 14	—16 24
3700	238 36	99 22 30	...	282 45 2	— 8 56
3800	196 24	308 49 0	...	282 44 51	— 1 29
3900	154 12	158 15 30	...	282 44 39	+ 5 59
4000	112 0	7 42 0	9° 2′ 0″	282 44 28	+13 27
4100	69 48	217 8 30	218 30 30	282 44 16	+20 54
4200	27 36	66 35 0	67 59 0	282 44 4	+28 22
4300	345 24	276 1 30	277 27 30	282 43 53	—24 10
4400	303 12	125 28 0	126 56 0	282 43 41	—16 43
4500	261 0	334 54 30	336 24 30	282 43 30	— 9 15
4600	218 48	184 21 0	185 53 0	282 43 18	— 1 47
4700	176 36	33 47 30	35 21 30	282 43 6	+ 5 40
4800	134 24	243 14 0	244 50 0	282 42 55	+13 08
4900	92 12	92 40 30	94 48 30	282 42 43	+20 36
5000	50 0	302 7 0	303 47 0	282 42 31	—31 57

ÂRYA SIDDHÂNTA.[1]

Cent. K. Y.	Dist. ☾ − ⊙ corrected.	☾'s Anomaly. Uncorrected.	☾'s Anomaly. Corrected.	Cor.
				gh. p.
3000	Distance uncorrected is identical with the *Sûrya Siddhânta* values of the same.	69° 15′ 0″	...	— 2 30
3100		275 33 30	...	+ 5 25
3200		127 52 0	...	+13 20
3300		337 10 30	...	+21 15
3400		186 29 0	...	+30 10
3500	...	35 47 30	...	—22 55
3600	280° 48	245 6 0	245° 6′ 0″	—15 0
3700	238 26	94 24 30	95 0 6	— 7 5
3800	196 4	303 43 0	304 54 12	+ 0 50
3900	153 42	153 1 30	154 48 18	+ 8 45
4000	111 20	2 20 0	4 44 24	+16 40
4100	68 58	211 38 30	214 36 30	+24 35
4200	26 36	60 57 0	64 30 36	+32 30
4300	344 24	270 15 30	274 24 42	—19 35
4400	301 52	119 34 0	124 18 48	—11 40
4500	259 30	328 52 30	334 12 54	— 3 45
4600	217 8	178 11 0	184 7 0	+ 4 10
4700	174 46	27 29 30	34 1 6	+12 5
4800	132 24	236 48 0	243 55 12	+2[illegible] 0
4900	90 2	86 6 30	94 49 18	+27 55
5000	47 40	295 25 0	303 43 24	—24 10

TABLE XIII.—continued.

BRAHMA SIDDHÂNTA.

Cent. K. Y.	Dist. ☾ − ⊙	☾'s Anom.	⊙'s Anom.	Cor.
				gh. p.
3000	165° 0′	53° 2′ 22″	282° 7′ 12″	—18 45
3100	122 30	262 59 26	282 6 58	— 9 22
3200	80 0	112 56 30	282 6 43	+ 0 0
3300	37 30	322 53 35	282 6 29	+ 9 23
3400	355 0	172 50 39	282 6 14	+18 45
3500	312 30	22 47 43	282 6 0	—31 52
3600	270 0	232 44 47	282 5 46	—22 30
3700	227 30	82 41 52	282 5 31	—13 07
3800	185 0	292 38 56	282 5 17	— 3 45
3900	142 30	142 36 0	282 5 2	+ 5 37
4000	100 0	352 33 4	282 4 48	+14 59
4100	57 30	202 30 9	282 4 34	+24 22
4200	15 0	52 27 13	282 4 19	+33 44
4300	332 30	262 24 17	282 4 5	—16 53
4400	290 0	112 21 21	282 3 50	— 7 31
4500	247 30	322 18 26	282 3 36	+ 1 52
4600	205 0	172 15 30	282 3 22	+11 14
4700	162 30	22 12 34	282 3 7	+20 37
4800	120 0	232 9 38	282 2 53	+29 59
4900	77 30	82 6 43	282 2 38	+39 22
5000	35 0	292 3 47	282 2 24	—11 16

SIDDHÂNTA ŚIROMANI.

Cent. K. Y.	Dist. ☾ − ⊙	☾'s Anom.	⊙'s Anom.	Cor.
3000	164° 30′	52° 17′ 22″	281° 22′ 12″	Same as for *Brahma Siddhânta*; but the day to be taken in Table XVI is 1 in advance of that found by the General Table.
3100	121 59	262 12 56	281 20 28	
3200	79 28	162 8 30	281 18 43	
3300	36 57	322 4 5	281 16 59	
3400	354 26	171 59 39	281 15 14	
3500	311 55	21 55 13	281 13 30	
3600	269 24	231 50 47	281 11 46	
3700	226 53	81 46 22	281 10 1	
3800	184 22	291 41 56	281 8 17	
3900	141 51	141 37 30	281 6 32	
4000	99 20	351 33 4	281 4 48	
4100	56 49	201 28 39	281 3 4	
4200	14 18	51 24 13	281 1 19	
4300	331 47	261 19 47	280 59 35	
4400	289 16	111 15 21	280 57 50	
4500	246 45	321 10 56	280 56 6	
4600	204 14	171 6 30	280 54 22	
4700	161 43	21 2 4	280 52 37	
4800	119 12	230 57 38	280 50 53	
4900	76 41	80 53 13	280 49 8	
5000	34 10	290 48 47	280 47 24	

[1] ⊙'s An.=282° throughout.

TABLE XIV.—*Sûrya Siddhânta: Years of the Century.*

Yr.	Dist. ☾—☉	☾'s Anomaly. Without *Bîja*.	☾'s Anomaly. With *Bîja*.	Cor.	Yr.	Dist. ☾—☉	☾'s Anomaly. Without *Bîja*.	☾'s Anomaly. With *Bîja*.	Cor.
				gh. p.					*gh. p*
0	0° 0′ 0″	0° 0′ 0″	0° 0′ 0″	0 0	50	158° 54′ 0″	284° 43′ 15″	284° 44′ 15″	+ 3 44
1	132 46 41	92 5 40	92 5 41	−15 32	51	291 40 41	16 48 55	16 49 56	−11 47
2	265 33 22	184 11 20	184 11 22	−31 3	52	64 27 22	108 54 35	108 55 37	−27 19
3	38 20 3	276 17 0	276 17 3	+13 25	53	197 14 2	201 0 15	201 1 18	+17 10
4	171 6 43	8 22 40	8 22 44	− 2 6	54	330 0 43	293 5 55	293 6 59	+ 1 38
5	303 53 24	100 28 20	100 28 26	−17 38	55	102 47 24	25 11 34	25 12 41	−13 54
6	76 40 5	192 33 59	192 34 7	−33 9	56	235 34 5	117 17 14	117 18 22	−29 25
7	209 26 46	284 39 39	284 39 48	+11 19	57	8 20 46	209 22 54	209 24 3	+15 3
8	342 13 26	16 45 19	16 45 29	− 4 12	58	141 7 26	301 28 34	301 29 44	− 0 28
9	115 0 7	108 50 59	108 51 10	−19 44	59	273 54 7	33 34 14	33 35 25	−16 0
10	247 46 48	200 56 39	200 56 51	−35 15	60	46 40 48	125 39 54	125 41 6	−31 31
11	20 33 29	293 2 19	293 2 32	+ 9 13	61	179 27 29	217 44 34	217 45 47	+12 57
12	153 20 10	25 7 59	25 8 13	− 6 18	62	312 14 10	309 51 14	309 52 28	− 2 34
13	286 6 50	117 13 39	117 13 54	−21 50	63	85 0 50	41 56 54	41 58 9	−18 6
14	58 53 31	209 19 19	209 19 35	+22 39	64	217 47 31	134 2 34	134 3 50	−33 37
15	191 40 12	301 24 59	301 25 17	+ 7 7	65	350 34 12	226 8 14	226 9 32	+10 51
16	324 26 53	33 30 38	33 30 58	− 8 24	66	123 20 53	318 13 53	318 15 13	− 4 41
17	97 13 34	125 36 18	125 36 39	−23 56	67	256 7 37	50 19 33	50 20 54	−20 12
18	230 0 14	217 41 58	217 42 20	+20 32	68	28 54 14	142 25 13	142 26 35	−35 44
19	2 46 55	309 47 38	309 48 1	+ 5 1	69	161 40 55	234 30 53	234 32 16	+ 8 45
20	135 33 36	41 53 18	41 53 42	−10 30	70	294 27 36	326 36 33	326 37 57	− 6 47
21	268 20 17	133 58 58	133 59 23	−26 2	71	67 14 17	58 42 13	58 43 38	−22 18
22	41 6 58	226 4 38	226 5 4	+16 26	72	200 0 58	150 47 53	150 49 19	+22 10
23	173 53 38	318 10 18	318 10 45	+ 2 55	73	332 47 38	242 53 33	242 55 0	+ 6 39
24	306 40 19	50 15 58	50 16 26	−12 37	74	105 34 19	334 59 13	335 0 41	− 8 53
25	79 27 0	142 21 38	142 22 8	−28 8	75	238 21 0	67 4 53	67 6 23	−24 24
26	212 13 41	234 27 17	234 27 49	+16 20	76	11 7 41	159 10 32	159 12 4	+20 4
27	345 0 22	326 32 57	326 33 30	+ 0 49	77	143 54 22	251 16 12	251 17 45	+ 4 33
28	117 47 3	58 38 37	58 39 11	−14 43	78	276 41 2	343 21 52	343 23 26	−10 59
29	250 33 43	150 44 17	150 44 52	−30 14	79	49 27 43	75 27 32	75 29 7	−26 30
30	23 20 24	242 49 57	242 50 33	+14 14	80	182 14 24	167 33 12	167 34 48	+17 58
31	156 7 5	334 55 37	334 56 14	− 1 17	81	315 1 5	259 38 52	259 40 29	+ 2 27
32	288 53 46	67 1 17	67 1 55	−16 49	82	87 47 46	351 44 32	351 46 10	−13 5
33	61 40 26	159 6 57	159 7 36	−32 20	83	220 34 26	83 50 12	83 51 51	−28 36
34	194 27 7	251 12 37	251 13 17	+12 8	84	353 21 7	175 55 52	175 57 32	+15 52
35	327 13 48	343 18 17	343 18 59	− 3 13	85	126 7 48	268 1 32	268 3 14	+ 0 21
36	100 0 29	75 23 56	75 24 40	−18 55	86	258 54 29	0 7 11	0 8 55	−15 11
37	232 47 10	167 29 36	167 30 21	−34 26	87	31 41 10	92 12 51	92 14 36	−30 42
38	5 33 50	259 35 16	259 36 2	+10 2	88	164 27 50	184 18 31	184 20 17	+13 46
39	138 20 31	351 40 56	351 41 43	− 5 29	89	297 14 31	276 24 11	276 25 58	− 1 45
40	271 7 12	83 46 36	83 47 24	−21 1	90	70 1 12	8 29 51	8 31 39	−17 17
41	43 53 53	175 52 16	175 53 5	−36 32	91	202 47 53	100 35 31	100 37 20	−32 49
42	176 40 34	267 57 56	267 58 46	+ 7 56	92	335 34 37	192 41 11	192 43 1	+11 40
43	309 27 14	0 3 36	0 4 27	− 7 35	93	108 21 14	284 46 51	284 48 42	− 3 52
44	82 13 55	92 9 16	92 10 8	−23 7	94	241 7 55	16 52 31	16 54 23	−19 23
45	215 0 36	184 14 56	184 15 50	+21 22	95	13 54 36	108 58 11	108 0 5	−34 55
46	347 47 17	276 20 35	276 21 31	+ 5 50	96	146 41 17	201 3 50	201 5 46	+ 9 34
47	120 33 58	8 26 15	8 27 12	− 9 41	97	279 27 58	293 9 30	293 11 27	− 5 58
48	253 20 38	100 33 55	100 34 53	−25 13	98	52 14 38	25 15 10	25 17 8	−21 29
49	26 7 19	192 39 35	192 40 34	+19 16	99	185 1 19	117 20 50	117 22 49	−37 1
50	158 54 0	284 43 15	284 44 15	+ 3 44	100	317 48 0	209 26 30	209 28 30	+ 7 2[illegible]

TABLE XV.—*Ārya Siddhānta* (*with Lalla's corrections*) : *Years of the century.*

Yr.	Distance ☾—☉.	☾'s Anom.	Cor.	Yr.	Distance ☾—☉.	☾'s Anom.	Cor.
			gh. v.				*gh. v.*
0	0° 0′ 0″	0° 0′ 0″	0 0	50	158° 49′ 0″	284° 57′ 3″	+ 3 58
1	132 46 35	92 5 56	—15 31	51	291 35 35	17 2 59	—11 34
2	265 33 10	184 11 53	—31 2	52	64 22 10	109 8 56	—27 5
3	38 19 44	276 17 49	+13 26	53	197 8 34	201 14 52	+17 24
4	171 6 19	8 23 46	—2 5	54	329 55 19	293 20 48	+ 1 53
5	303 52 54	100 29 42	—17 36	55	102 41 55	25 26 45	—13 39
6	76 39 29	192 35 39	—33 7	56	235 28 29	117 32 41	—29 10
7	209 26 4	284 41 35	+11 21	57	8 15 4	209 38 37	+15 19
8	342 12 38	16 47 32	—4 10	58	141 1 38	301 44 34	— 0 12
9	114 59 13	108 53 28	—19 41	59	273 48 13	33 50 31	—15 44
10	247 45 48	200 59 25	—35 12	60	46 34 48	125 56 28	—31 15
11	20 32 23	293 5 21	+9 16	61	179 21 23	218 2 24	+13 14
12	153 18 58	25 11 18	—6 15	62	342 7 58	310 8 20	— 2 17
13	286 5 32	117 17 14	—21 46	63	84 54 32	42 14 17	—17 49
14	58 52 7	209 23 10	+22 43	64	217 41 7	134 20 13	—30 20
15	191 38 42	301 29 7	+7 11	65	350 27 42	226 26 10	+11 9
16	324 25 17	33 35 3	—8 20	66	123 14 17	318 32 7	— 4 12
17	97 11 52	125 41 0	—23 51	67	256 0 52	50 38 3	—19 54
18	229 58 26	17 46 56	+20 37	68	8 47 26	142 43 59	—35 25
19	2 45 1	309 52 53	+5 6	69	161 34 1	234 49 55	+ 9 4
20	135 31 36	41 58 49	—10 25	70	294 20 36	326 55 52	— 6 27
21	268 18 11	134 4 46	—25 56	71	67 7 11	59 1 48	—21 59
22	41 4 46	226 10 42	+18 33	72	199 53 46	151 7 44	+22 30
23	173 51 20	318 16 39	+3 1	73	332 40 20	243 13 41	+ 6 59
24	306 37 55	50 22 35	—12 30	74	105 26 55	325 19 38	— 8 32
25	79 24 30	142 28 31	—28 1	75	238 13 30	67 25 34	—24 4
26	212 11 5	234 34 28	+16 28	76	11 0 5	159 31 30	+20 25
27	344 57 40	326 40 24	+0 56	77	143 46 40	251 37 27	+ 4 54
28	117 44 14	58 46 20	—14 35	78	276 33 14	343 43 23	—10 37
29	250 30 49	150 52 16	—30 6	79	49 19 49	75 49 20	—26 9
30	23 17 24	242 58 14	+14 23	80	182 6 24	167 55 17	+18 20
31	156 3 59	335 4 10	—1 9	81	314 52 53	259 1 13	+ 2 49
32	288 50 34	67 10 6	—16 40	82	87 39 34	352 7 9	—12 42
33	61 38 8	159 16 3	—32 11	83	220 26 8	84 13 6	—28 14
34	194 23 43	251 21 59	+12 18	84	253 12 43	176 19 2	+16 15
35	327 10 18	343 27 55	—3 13	85	125 59 18	268 24 59	+ 0 44
36	99 56 53	75 33 53	—18 45	86	258 45 53	0 30 55	—14 47
37	232 43 28	167 39 49	—34 16	87	31 32 28	92 36 51	—30 19
38	5 30 2	259 45 45	+10 13	88	164 19 2	184 42 49	+14 10
39	138 16 37	351 51 42	—5 19	89	297 5 37	276 48 45	— 1 21
40	271 3 12	83 57 38	—20 50	90	69 52 12	8 54 41	—16 52
41	43 49 47	176 3 34	—36 21	91	202 38 47	101 0 37	—32 24
42	176 36 22	268 9 31	+8 8	92	335 25 22	193 6 34	+12 5
43	309 22 56	0 15 27	—7 24	93	108 11 56	285 12 30	— 3 26
44	82 9 31	92 21 23	—22 55	94	240 58 31	17 18 27	—18 57
45	214 56 6	184 27 20	+21 33	95	13 45 6	109 24 24	—34 29
46	347 42 41	276 33 16	+6 3	96	146 31 41	201 30 20	+10 0
47	120 29 16	8 39 12	—9 28	97	279 18 16	293 36 17	— 5 31
48	253 15 50	100 45 9	—25 0	98	52 4 50	25 42 13	—21 2
49	26 2 25	192 51 6	+19 29	99	184 51 25	117 48 9	—36 34
50	158 49 0	284 57 3	+ 3 58	100	317 38 0	209 54 6	+ 7 55

TABLE XVI.—*Brahma Siddhânta.—Years of the century.*[1]

Yr.	Distance ☾—☉	☾'s Anom.	Cor.	Yr.	Distance ☾—☉	☾'s Anom.	Cor.
			gh. p.				*gh. p.*
0	0° 0′ 0″	0° 0′ 0″	0 0	50	158° 45′ 0″	284° 58′ 32″	+ 4 41
1	132 46 30	92 5 58	—15 30	51	291 31 30	16 4 30	—10 49
2	265 33 0	184 11 56	—31 1	52	64 18 0	109 10 28	—26 19
3	38 19 30	276 17 55	+13 29	53	197 4 30	201 16 26	+18 10
4	171 6 0	8 23 53	— 2 2	54	329 51 0	293 22 25	+ 2 40
5	303 52 30	100 29 51	—17 32	55	102 37 30	25 28 23	—12 51
6	76 39 0	192 35 49	—33 2	56	235 24 0	117 34 21	—28 21
7	209 25 30	284 41 47	+11 27	57	8 10 30	209 40 19	+16 9
8	342 12 0	16 47 45	— 4 3	58	140 57 0	301 46 17	+ 0 38
9	114 58 30	108 53 43	—19 33	59	273 43 30	33 52 16	—14 52
10	247 45 0	200 59 42	—35 3	60	46 30 0	125 58 15	—30 22
11	20 31 30	293 5 40	+ 9 26	61	179 16 30	217 4 13	+14 7
12	153 18 0	25 11 38	— 6 4	62	312 3 0	310 10 11	— 1 23
13	286 4 30	117 17 37	—21 35	63	84 49 30	42 16 9	—16 54
14	58 51 0	209 23 36	+22 55	64	217 36 0	134 22 8	—32 24
15	191 37 30	301 29 33	+ 7 24	65	350 22 30	226 28 6	+12 6
16	324 24 0	33 35 31	— 8 6	66	123 9 0	318 34 4	— 3 25
17	97 10 30	125 41 29	—23 36	67	255 55 30	50 40 2	—18 55
18	229 57 0	217 47 28	+20 53	68	8 42 0	142 46 0	—34 25
19	2 43 30	309 53 26	+ 5 23	69	161 28 30	234 51 58	+10 4
20	135 30 0	41 59 25	—10 7	70	294 15 0	326 57 57	— 5 26
21	268 16 30	134 5 23	—25 38	71	67 1 30	59 3 55	—20 57
22	41 3 0	226 11 21	+ 8 52	72	199 48 0	151 9 53	+23 33
23	73 49 30	318 17 20	+ 3 21	73	332 34 30	243 15 51	+ 8 3
24	306 36 0	50 23 18	—12 9	74	105 21 0	335 21 50	— 7 28
25	79 22 30	142 29 16	—27 39	75	238 7 30	67 27 48	—22 58
26	212 9 0	234 35 14	+16 51	76	10 54 0	159 33 46	+21 32
27	344 55 30	326 41 12	+ 1 20	77	143 40 30	251 39 44	+ 6 1
28	117 42 0	58 47 10	—14 10	78	276 27 0	343 45 43	— 9 29
29	250 28 30	150 53 9	—29 41	79	49 13 30	75 51 41	—25 0
30	23 15 0	242 59 7	+14 49	80	182 0 0	167 57 39	+19 30
31	156 1 30	335 5 5	— 0 42	81	314 46 30	260 3 38	+ 4 0
32	288 48 0	67 11 3	—16 12	82	87 33 0	352 9 36	—11 31
33	61 34 30	159 17 2	—31 42	83	220 19 30	84 15 34	—27 1
34	194 21 0	251 23 0	+12 57	84	353 6 0	176 21 33	+17 29
35	327 7 30	343 28 58	— 2 43	85	125 52 30	268 27 31	+ 1 58
36	99 54 0	75 34 57	—18 13	86	258 39 0	0 33 29	—13 32
37	232 40 30	167 40 55	—33 44	87	31 25 30	92 39 27	—29 3
38	5 27 0	259 46 53	+10 46	88	164 12 0	184 45 25	+15 27
39	138 13 30	351 52 51	— 4 45	89	297 58 30	276 51 23	— 0 3
40	271 0 0	83 58 50	—22 15	90	69 45 0	8 57 22	—15 34
41	43 46 30	176 4 48	—35 45	91	202 31 30	101 3 20	—31 4
42	176 33 0	268 10 46	+ 8 44	92	335 18 0	193 9 18	+13 26
43	309 19 30	0 16 45	— 6 46	93	108 4 30	285 15 17	— 2 5
44	82 6 0	92 22 43	—22 16	94	240 51 0	17 21 15	—17 35
45	214 52 30	184 28 41	+22 13	95	13 37 30	109 27 13	—33 6
46	347 39 0	276 34 39	+ 6 44	96	146 24 0	201 33 11	+11 24
47	120 25 30	8 40 37	— 8 47	97	279 10 30	293 39 9	— 4 6
48	253 12 0	100 46 35	—24 18	98	52 57 0	25 45 7	—19 37
49	25 58 30	192 52 34	+20 12	99	184 43 30	117 51 6	—35 7
50	158 45 0	284 58 32	+ 4 41	100	317 30 0	209 57 4	+ 9 22

[1] For the *Siddhânta Śiromaṇi*, correct the values in this table by means of Table XIX.

TABLE XVIII[1].—*Second Ârya Siddhânta.—Years of the century.*

Yr.	Distance ☾—☉.	☾'s Anom.	Cor.	Yr.	Distance ☾—☉.	☾'s Anom.	Cor.
			gh. p.				gh. p.
0	0° 0′ 0″	0° 0′ 0″	0 0	50	158° 53′ 30″	285° 5′ 34″	+ 3 56
1	132 46 40	92 6 7	—15 31	51	291 40 10	16 11 41	—11 36
2	265 33 20	184 12 13	—31 2	52	64 26 50	109 17 47	—27 7
3	38 20 0	276 18 20	+13 26	53	197 13 30	201 23 54	+17 22
4	171 6 40	8 24 26	— 2 5	54	330 0 10	293 30 0	+ 1 51
5	303 53 21	100 30 33	—17 36	55	102 46 51	25 36 7	—13 41
6	76 40 1	192 36 40	—33 7	56	235 33 31	117 42 14	—29 12
7	209 26 41	284 42 47	+11 21	57	8 20 11	209 48 21	+15 17
8	342 13 21	16 48 54	— 4 10	58	141 6 51	301 52 28	— 0 14
9	115 0 1	108 55 0	—19 41	59	273 53 31	33 58 34	—15 46
10	247 46 42	201 1 7	—35 12	60	46 40 12	126 6 40	—31 17
11	20 33 22	293 7 13	+ 9 16	61	179 27 52	218 12 47	+13 12
12	153 20 2	25 13 20	— 9 15	62	312 13 32	310 18 53	— 2 19
13	286 6 42	117 19 27	—21 46	63	85 0 12	42 25 0	—17 51
14	58 53 22	209 25 33	+22 43	64	217 46 52	134 31 6	—30 22
15	191 40 3	301 31 40	+ 7 10	65	350 33 33	226 37 13	+11 7
16	324 26 43	33 37 47	— 8 21	66	123 20 13	318 43 20	— 4 14
17	97 13 23	125 43 54	—23 52	67	256 6 53	50 49 27	—19 56
18	230 0 3	217 50 1	+20 36	68	28 53 33	142 55 34	—35 27
19	2 46 43	309 56 7	+ 5 5	69	161 40 13	235 1 40	+ 9 2
20	135 33 24	42 2 13	—10 26	70	294 26 54	327 7 47	— 6 29
21	268 20 4	134 8 20	—25 57	71	67 13 34	59 13 54	—22 1
22	41 6 44	226 14 26	+18 32	72	200 0 14	151 20 0	+22 28
23	173 53 24	318 20 33	+ 3 0	73	332 46 54	243 26 7	+ 6 57
24	306 40 4	50 26 39	—12 31	74	105 33 34	335 32 13	— 8 34
25	79 26 45	142 32 46	—28 2	75	238 20 15	67 38 20	—24 7
26	212 13 25	234 38 53	+16 27	76	11 6 55	159 44 27	+20 22
27	345 0 5	326 45 0	+ 0 55	77	143 53 35	251 50 34	÷ 4 51
28	117 46 45	58 51 7	—14 36	78	276 40 15	343 56 41	—10 40
29	250 33 25	150 57 13	—30 7	79	49 26 55	76 2 47	—26 12
30	23 20 6	243 3 20	+14 21	80	182 13 36	168 8 54	+18 18
31	156 6 46	335 9 27	— 1 10	81	315 0 16	260 15 1	+ 2 47
32	288 53 26	67 15 33	—16 41	82	87 46 56	352 21 7	—12 46
33	61 40 6	159 21 40	—32 12	83	220 33 36	84 27 14	—28 17
34	194 26 46	251 27 56	+12 17	84	353 20 16	176 33 20	+16 12
35	327 13 27	343 34 3	— 3 14	85	126 6 57	268 39 27	+ 0 41
36	100 0 7	75 40 10	—18 46	86	258 53 37	0 45 34	—14 50
37	232 46 47	167 46 17	—34 17	87	31 40 17	92 51 41	—30 22
38	5 33 27	259 52 24	+10 12	88	164 26 57	184 57 48	+14 7
39	138 20 7	351 58 20	— 5 20	89	297 13 37	277 3 54	— 1 24
40	271 6 48	84 4 27	—20 51	90	70 0 18	9 10 1	—16 55
41	43 53 28	176 10 34	—36 22	91	202 46 58	101 16 8	—32 27
42	176 40 8	268 16 40	+ 8 7	92	335 33 38	193 22 14	+12 2
43	309 26 48	0 22 47	— 7 25	93	108 20 18	285 28 21	— 3 28
44	82 13 28	92 28 53	—22 56	94	241 7 58	17 34 27	—19 0
45	215 0 9	184 35 0	+21 31	95	13 53 39	109 40 34	—34 32
46	347 46 49	276 41 7	+ 6 1	96	146 40 19	201 46 41	+ 9 57
47	120 33 29	8 47 14	— 9 30	97	279 26 59	293 52 48	— 5 34
48	253 20 9	100 53 21	—25 2	98	52 13 39	25 58 55	—21 5
49	26 6 49	192 59 27	+29 27	99	185 0 19	118 5 1	—36 37
50	158 53 30	285 5 34	+3 56	100	317 47 0	210 11 8	+ 7 51

[1] Table XVII for Centuries is on the next page.

Table XVII.—*Second Ârya Siddhânta: For centuries.*

Cent. K.Y.	Distance (☾−☉).		☾'s Anom.			☉'s Anom.			Cor.	
									gh.	*p.*
3000	173°	30′	61°	43′	24″	282°	7′	29″	− 4	15
3100	131	17	271	54	32	282	7	15	+ 3	37
3200	89	4	122	5	39	282	7	1	+11	28
3300	46	51	332	16	47	282	6	48	+19	20
3400	4	38	182	27	54	282	6	34	+27	11
3500	322	25	32	39	2	282	6	20	−24	57
3600	280	12	242	50	10	282	6	6	−17	06
3700	237	59	93	1	17	282	5	52	− 9	14
3800	195	46	303	12	25	282	5	39	− 1	23
3900	153	33	153	23	32	282	5	25	+ 6	29
4000	111	20	3	34	40	282	5	11	+14	20
4100	69	7	213	45	48	282	4	57	+22	12
4200	26	54	63	56	55	282	4	43	+30	03
4300	344	41	274	8	3	282	4	30	−22	05
4400	302	28	124	19	10	282	4	16	−14	14
4500	260	15	334	30	18	282	4	2	− 6	22
4600	218	2	184	41	26	282	3	48	+ 1	29
4700	175	49	34	52	33	282	3	34	+ 9	21
4800	133	36	245	3	41	282	3	21	+17	12
4900	91	23	95	14	48	282	3	7	+25	04
5000	49	10	305	25	56	282	2	53	−27	05

Table XIX.—*Siddh. S'iromaṇi*

Quantities to be subtracted from *Brahma Siddhânta* values.

Yr.	Dist. (☾−☉).		☾ & ☉'s Anom.	
5	0′	3″	0′	5″
10	0	6	0	9
15	0	9	0	14
20	0	12	0	18
25	0	15	0	23
30	0	18	0	27
35	0	21	0	32
40	0	24	0	36
45	0	27	0	41
50	0	30	0	45
55	0	33	0	50
60	0	36	0	54
65	0	39	0	59
70	0	42	1	3
75	0	45	1	8
80	0	48	1	12
85	0	51	1	17
90	0	54	1	21
95	0	57	1	26
100	1	0	1	30

Table XX.—*Saṁkrânti.*

Saṁkrânti.	True ☉'s Long.	Distance ☾−☉.			☾'s Anom.			Mean Long. ☉			Date.	*g.*	*p.*
Mîna-Saṁkrânti	330°	313°	30′	9″	295°	4′	8″	327°	56′	39″	0 *Chaitra*	31	30
Mesha-Saṁkrânti	0	343	32	22	331	38	30	357	51	38	0 Vaiś.	49	56
Vṛisha-S.	30	350	39	25	15	48	10	28	20	59	0 Jyaish.	45	51
Mithuna-S.	60	13	42	13	66	19	7	59	19	7	1 Âshâḍha	11	7
Karkaṭa-S.	90	39	28	36	119	44	23	90	30	28	0 Śrâ.	49	48
Siṁha-S.	120	63	6	33	180	54	0	121	31	25	1 Bhâdr.	17	57
Kanyâ-S.	150	81	19	15	226	14	1	152	6	41	1 Âśvina	19	25
Tulâ-S.	180	92	25	14	263	56	46	182	6	16	0 Kârtt.	45	53
Vṛiśchika-S.	210	96	49	57	294	29	25	211	34	4	0 Mârg.	39	26
Dhanuh-S.	240	96	21	17	319	47	39	240	38	0	1 Pausha	8	55
Makara-S.	270	93	45	49	342	50	1	269	31	46	1 Mâgha	28	0
Kumbha-S.	300	92	45	15	7	34	5	298	33	11	0 Phâlg.	54	52
Mîna-S.	330	96	17	33	37	7	35	327	56	41	0 Chaitra	44	7
Mesha-S. foll.	360	106	19	33	73	44	42	357	51	41	1 *Vaiś*	5	20

Table XXI.—*For days of the Solar Year.*

Day.	Ah.	☾−☉.			☾'s Anom.			Long. ☉		
Chaitra of preceding year.										
0	−33	317°	42′	19″	288°	51′	21″	327°	28′	31″
1	−32	329	53	46	301	55	15	328	27	39
2	−31	342	5	12	314	59	9	329	26	47
3	−30	354	16	39	328	3	3	330	25	55
4	−29	6	28	5	341	6	57	331	25	4
5	−28	18	39	32	354	10	51	332	24	12
6	−27	31	50	59	7	14	45	333	23	20
7	−26	43	2	26	20	18	39	334	22	28
8	−25	55	13	53	33	22	33	335	21	36
9	−24	67	25	19	46	26	26	336	20	44
10	23	79	36	56	59	30	20	337	19	53
11	−22	91	48	13	72	34	14	338	19	1
12	−21	103	59	39	85	38	8	339	18	9
13	−20	116	11	6	98	42	2	340	17	17
14	−19	128	22	33	111	45	56	341	16	25
15	−18	140	33	59	124	49	50	342	15	33
16	−17	152	55	26	137	53	44	343	14	41
17	−16	164	56	53	150	57	38	344	13	49
18	−15	177	8	19	164	2	32	345	12	57
19	−14	189	19	46	177	5	25	346	12	6
20	−13	201	31	13	190	9	29	347	11	14
21	−12	213	42	40	203	13	13	348	10	22
22	−11	225	54	6	216	17	7	349	9	30
23	−10	238	5	33	229	21	1	350	8	38
24	− 9	250	17	0	242	24	55	351	7	46
25	− 8	262	28	26	255	28	49	352	6	55
26	− 7	274	39	53	268	32	43	353	6	3
27	− 6	286	51	20	281	36	37	354	5	11
28	− 5	299	2	47	294	40	31	355	4	19
29	− 4	311	14	13	307	44	24	356	3	27
1. Vaiśâkha.										
0	−3	323°	25′	40″	320°	48′	18″	357°	2′	35
1	−2	335	37	7	333	52	12	358	1	44
2	−1	347	48	33	346	56	6	359	0	52
3	0	0	0	0	0	0	0	0	0	0
4	1	12	11	27	13	3	54	0	59	8
5	2	24	22	53	26	7	48	1	58	16
6	3	36	34	20	39	11	42	2	57	25
7	4	48	45	47	52	15	36	3	56	33
8	5	60	57	13	65	19	29	4	55	41
9	6	73	8	40	78	23	23	5	54	49
10	7	85	20	7	91	27	17	6	53	57
11	8	97	31	34	104	31	11	7	53	5
12	9	109	43	0	117	35	5	8	52	14
13	10	121	54	27	130	38	59	9	51	22
14	11	134	5	54	143	42	53	10	50	30
15	12	146	17	20	156	46	47	11	49	38
16	13	158	28	47	169	50	41	12	48	46
17	14	170	40	14	182	54	35	13	47	54
18	15	182	51	40	195	58	28	14	47	3
19	16	195	3	7	209	2	22	15	46	11
20	17	207	14	34	222	6	16	16	45	19
21	18	219	26	1	235	10	10	17	44	27
22	19	231	37	27	248	14	4	18	43	35
23	20	243	48	54	261	17	58	19	42	43
24	21	256	0	21	274	21	52	20	41	51
25	22	268	11	47	287	25	46	21	40	59
26	23	280	23	14	300	29	40	22	40	7
27	24	292	34	41	313	33	34	23	39	16
28	25	304	46	7	326	37	27	24	38	24
29	26	316	57	34	339	41	21	25	37	32
30	27	329	9	1	352	45	15	26	36	40

TABLE XXI.—*For days of the Solar Year*—continued.

Day.	2. JYAISHTHA. Ahar.	Distance ☾—☉.	☾'s Anom.	Long.☉	4. ŚRÂVANA. Ahar.	Distance ☾—☉.	☾'s Anom.	Long.☉	6. ÂŚVINA. Ahar.	Distance ☾—☉.	☾'s Anom.	Long.☉	Day.
0	28	341° 20′ 28″	5° 49′ 9″	27° 35′ 48″	91	29° 21′ 30″	108° 54′ 45″	89° 41′ 23″	153	65° 11′ 5″	208° 56′ 26″	150° 47′ 49″	0
1	29	353 31 54	18 53 3	28 34 56	92	41 32 56	121 58 39	90 40 31	154	77 22 32	222 0 20	151 46 57	1
2	30	5 43 21	31 56 57	29 34 5	93	53 44 23	135 2 33	91 39 39	155	89 34 58	235 4 14	152 46 6	2
3	31	17 54 48	45 0 51	30 33 13	94	65 55 50	148 6 27	92 38 47	156	101 45 25	248 8 8	153 45 14	3
4	32	30 6 14	58 4 45	31 32 21	95	78 7 16	161 10 20	93 37 56	157	113 56 52	261 12 2	154 44 22	4
5	33	42 17 41	71 8 39	32 31 29	96	90 18 43	174 14 14	94 37 4	158	126 8 19	274 15 56	155 43 30	5
6	34	54 29 8	84 12 33	33 30 37	97	102 30 10	187 18 8	95 36 12	159	138 19 45	287 19 50	156 42 38	6
7	35	66 40 34	97 16 26	34 29 46	98	114 41 37	200 22 2	96 35 20	160	150 31 12	300 23 44	157 41 47	7
8	36	78 52 1	110 20 20	35 28 54	99	126 53 3	213 25 56	97 34 28	161	162 42 39	313 27 38	158 40 55	8
9	37	91 3 28	123 24 14	36 28 2	100	139 4 30	226 29 49	98 33 37	162	174 54 5	326 31 32	159 40 3	9
10	38	103 14 55	136 28 8	37 27 10	101	151 15 56	239 33 43	99 32 45	163	187 5 32	339 35 26	160 39 11	10
11	39	115 26 21	149 32 2	38 26 18	102	163 27 22	252 37 37	100 31 53	164	199 16 59	352 39 20	161 38 19	11
12	40	127 37 48	162 35 56	39 25 27	103	175 38 51	265 41 31	101 31 1	165	211 28 25	5 43 13	162 37 28	12
13	41	139 49 15	175 39 50	40 24 35	104	187 50 17	278 45 25	102 30 9	166	223 39 52	18 47 7	163 36 36	13
14	42	152 0 41	188 43 44	41 23 43	105	200 1 44	301 49 18	103 29 18	167	235 51 19	31 51 1	164 35 44	14
15	43	164 12 8	201 47 38	42 22 51	106	212 13 11	314 53 12	104 28 26	168	248 2 46	44 54 55	165 34 52	15
16	44	176 23 35	214 51 32	43 21 59	107	224 24 37	327 57 6	105 27 34	169	260 14 12	57 58 49	166 34 0	16
17	45	188 35 1	227 55 25	44 21 7	108	236 36 4	341 1 0	106 26 42	170	272 25 39	71 2 43	167 33 9	17
18	46	200 46 28	240 59 19	45 20 16	109	248 47 31	354 4 56	107 25 50	171	284 37 8	84 6 37	168 32 17	18
19	47	212 57 55	254 3 13	46 19 24	110	260 58 57	7 8 48	108 24 59	172	296 48 32	97 10 31	169 31 25	19
20	48	225 9 22	267 7 7	47 18 32	111	273 10 24	20 12 42	109 24 7	173	308 59 59	110 14 25	170 30 33	20
21	49	237 20 48	280 11 1	48 17 40	112	285 21 50	33 16 36	110 23 15	174	321 11 26	123 18 19	171 29 41	21
22	50	249 32 15	293 14 55	49 16 48	113	297 33 17	46 20 30	111 22 23	175	333 22 52	136 22 12	172 28 50	22
23	51	261 43 42	306 18 49	50 15 57	114	309 44 44	59 24 24	112 21 31	176	345 34 19	149 26 6	173 27 58	23
24	52	273 55 8	319 22 43	51 15 5	115	321 56 10	72 28 17	113 20 39	177	357 45 46	162 30 0	174 27 6	24
25	53	286 6 35	332 26 37	52 14 13	116	334 7 37	85 32 11	114 19 48	178	9 57 13	175 33 54	175 26 14	25
26	54	298 18 2	345 30 30	53 13 21	117	346 19 4	98 36 5	115 18 56	179	22 8 39	188 37 48	176 25 22	26
27	55	310 29 28	358 34 24	54 12 29	118	358 30 31	111 39 59	116 18 4	180	34 20 6	201 41 42	177 24 31	27
28	56	322 40 55	11 38 18	55 11 37	119	10 41 57	124 43 43	117 17 12	181	46 31 33	214 45 36	178 23 39	28
29	57	334 52 22	24 42 12	56 10 45	120	22 53 24	137 47 47	118 16 20	182	58 42 59	227 49 30	179 22 47	29
30	58	347 3 49	37 46 6	57 9 53	121	35 4 51	150 51 41	119 15 23	183	70 54 26	240 53 24	180 21 55	30

Day.	3. ÂSHÂDHA. Ahar.	Distance ☾—☉.	☾'s Anom.	Long.☉	5. BHÂDRAPADA. Ahar.	Distance ☾—☉.	☾'s Anom.	Long.☉	7. KÂRTTIKA. Ahar.	Distance ☾—☉.	☾'s Anom.	Long.☉	Day.
0	59	359° 15′ 15″	50° 50′ 0″	58° 9′ 2″	122	47° 16′ 17″	163° 55′ 35″	120° 14′ 36″	184	83° 5′ 53″	253° 57′ 18″	181° 21′ 3″	0
1	60	11 26 42	63 53 53	59 8 10	123	59 27 44	176 59 29	121 13 44	185	95 17 19	267 1 11	182 20 12	1
2	61	23 38 9	76 57 47	60 7 18	124	71 39 11	190 3 23	122 12 52	186	107 28 46	280 5 5	183 19 20	2
3	62	35 49 35	90 1 41	61 6 26	125	83 50 37	203 7 16	123 12 1	187	119 40 13	293 8 59	184 18 28	3
4	63	48 1 2	103 5 35	62 5 34	126	96 2 4	216 11 10	124 11 9	188	131 51 40	306 12 53	185 17 36	4
5	64	60 12 29	116 9 29	63 4 42	127	108 13 31	229 15 4	125 10 17	189	144 3 6	319 16 47	186 16 44	5
6	65	72 23 55	129 13 22	64 3 51	128	120 24 58	242 18 58	126 9 25	190	156 14 33	332 20 41	187 15 52	6
7	66	84 35 22	142 17 16	65 2 59	129	132 36 24	255 22 42	127 8 33	191	168 26 0	345 24 35	188 15 0	7
8	67	96 46 49	155 21 10	66 2 7	130	144 47 51	268 26 46	128 7 42	192	180 37 26	358 28 29	189 14 8	8
9	68	108 58 16	168 25 4	67 1 15	131	156 59 18	281 30 40	129 6 50	193	192 48 53	11 32 23	190 13 16	9
10	69	121 9 42	181 28 58	68 0 23	132	169 10 44	294 34 34	130 5 58	194	205 0 20	24 36 17	191 12 24	10
11	70	133 21 9	194 32 52	68 59 32	133	181 22 11	307 38 28	131 5 6	195	217 11 46	37 40 10	192 11 33	11
12	71	145 32 36	207 36 46	69 58 40	134	193 33 38	320 42 22	132 4 14	196	229 23 13	50 44 4	193 10 40	12
13	72	157 44 2	220 40 40	70 57 48	135	205 45 4	333 46 15	133 3 23	197	241 34 40	63 47 58	194 9 49	13
14	73	169 55 29	233 44 34	71 56 56	136	217 56 31	346 50 9	134 2 31	198	253 46 7	76 51 52	195 8 57	14
15	74	182 6 56	246 48 28	72 56 4	137	230 7 58	359 54 3	135 1 39	199	265 57 33	89 55 46	196 8 3	15
16	75	194 18 22	259 52 21	73 55 13	138	242 19 26	12 57 57	136 0 47	200	278 9 0	102 59 38	197 7 14	16
17	76	206 29 49	272 56 15	74 54 21	139	254 30 52	26 1 51	136 59 55	201	290 20 27	116 3 32	198 6 23	17
18	77	218 41 16	286 0 9	75 53 29	140	266 42 18	39 5 45	137 59 4	202	302 31 53	129 7 26	199 5 30	18
19	78	230 52 43	299 4 3	76 52 37	141	278 53 45	52 9 39	138 58 12	203	314 43 20	142 11 20	200 4 39	19
20	79	243 4 9	312 7 57	77 51 45	142	291 5 11	65 13 33	139 57 20	204	326 54 47	155 15 14	201 3 47	20
21	80	255 15 36	325 11 52	78 50 53	143	303 16 38	78 17 27	140 56 28	205	339 6 13	168 19 7	202 2 55	21
22	81	267 27 3	338 15 46	79 50 1	144	315 28 5	91 21 21	141 55 36	206	351 17 40	181 23 1	203 2 3	22
23	82	279 38 29	351 19 40	80 49 9	145	327 39 31	104 25 14	142 54 44	207	3 29 7	194 26 55	204 1 11	23
24	83	291 49 56	4 23 34	81 48 17	146	339 50 58	117 29 8	143 53 53	208	15 40 34	207 30 49	205 0 19	24
25	84	304 1 23	17 27 28	82 47 25	147	352 2 25	130 33 2	144 53 1	209	27 52 0	220 34 43	205 59 27	25
26	85	316 12 50	30 31 21	83 46 34	148	4 13 52	143 36 56	145 52 9	210	40 3 27	233 38 37	206 58 38	26
27	86	328 24 16	43 35 15	84 45 42	149	16 25 18	156 40 50	146 51 17	211	52 14 54	246 42 31	207 57 44	27
28	87	340 35 43	56 39 9	85 44 50	150	28 36 45	169 44 44	147 50 25	212	64 26 20	259 46 25	208 56 52	28
29	88	352 47 10	69 43 3	86 43 58	151	40 48 12	182 48 38	148 49 33	213	76 37 47	272 50 19	209 56 0	29
30	89	4 58 36	82 46 57	87 43 6	152	52 59 38	195 52 32	149 48 41					30
31	90	17 10 3	95 50 51	88 42 75									31

TABLE XXI.—*For the days of the Solar Year*—continued.

Day.	8. MÂRGSIRA. Ahar.	Distance ☾—☉.	☾'s Anom.	Long. ☉	10. MÂGHA. Ahar.	Distance ☾—☉.	☾'s Anom.	Long. ☉	12. CHAITRA. Ahar.	Distance ☾—☉.	☾'s Anom.	Long. ☉	Day.
0	214	88° 49′ 14″	285° 54′ 13″	210° 55′ 8″	272	75° 53′ 2″	323° 40′ 18″	268° 5′ 2″	332	87° 19′ 44″	27° 34′ 12″	327° 13′ 12″	0
1	215	101 0 40	298 58 6	211 54 16	273	88 4 29	336 44 12	269 4 10	333	99 31 11	40 38 6	328 12 20	1
2	216	113 12 7	312 2 0	212 53 25	274	100 15 55	349 48 6	270 3 18	334	111 42 38	53 42 0	329 11 28	2
3	217	125 23 34	325 5 54	213 52 33	275	112 27 22	2 52 0	271 2 26	335	123 54 4	66 45 53	330 10 37	3
4	218	137 35 2	338 9 48	214 51 41	276	124 38 49	15 55 53	272 1 34	336	136 5 31	79 49 47	331 9 45	4
5	219	139 46 27	351 13 40	215 50 49	277	136 50 16	28 59 47	273 0 42	337	148 16 58	92 53 41	332 8 53	5
6	220	161 57 54	4 17 36	216 49 57	278	149 1 43	42 3 41	273 59 51	338	160 28 24	105 57 35	333 8 1	6
7	221	174 9 21	17 21 30	217 49 5	279	161 13 9	55 7 35	274 58 59	339	172 39 51	119 1 29	334 7 9	7
8	222	186 20 47	40 25 24	218 48 13	280	173 24 36	68 11 29	275 58 7	340	184 51 18	132 5 23	335 6 18	8
9	223	198 32 14	53 29 18	219 47 22	281	185 36 3	81 15 33	276 57 15	341	197 2 44	145 9 17	336 5 26	9
10	224	210 43 41	66 33 12	220 46 30	282	197 47 30	94 19 17	277 56 23	342	209 14 11	158 13 11	337 4 34	10
11	225	222 55 7	79 37 5	221 45 38	283	209 58 56	107 23 11	278 55 32	343	221 25 38	171 17 5	338 3 42	11
12	226	235 6 34	92 40 59	222 44 46	284	222 10 23	120 27 5	279 54 40	344	233 37 4	184 20 59	339 2 50	12
13	227	247 18 1	105 44 53	223 43 54	285	234 21 46	133 30 58	280 53 48	345	245 48 31	197 24 52	340 1 59	13
14	228	259 29 28	118 48 47	224 43 3	286	246 33 16	146 34 52	281 52 56	346	257 59 58	210 28 46	341 1 7	14
15	229	271 40 54	121 52 41	225 42 11	287	258 44 43	159 38 46	282 52 4	347	270 11 25	223 32 40	342 0 15	15
16	230	283 52 21	134 56 35	226 41 19	288	270 56 10	172 42 40	283 51 13	348	282 22 51	236 36 34	342 59 23	16
17	231	296 3 48	148 0 29	227 40 27	289	283 7 36	185 46 34	284 50 21	349	294 34 18	249 40 28	343 58 31	17
18	232	308 15 14	161 4 23	228 39 35	290	295 19 3	198 50 28	285 49 29	350	306 45 45	262 44 22	344 57 39	18
19	233	320 26 41	174 8 17	229 38 44	291	307 30 30	211 54 22	286 48 37	351	318 57 11	275 48 16	345 56 48	19
20	234	332 38 8	187 12 10	230 37 52	292	319 41 56	224 58 16	287 47 45	352	331 8 38	288 52 10	346 55 56	20
21	235	344 49 34	200 16 4	231 37 0	293	331 53 23	238 2 10	288 46 53	353	343 20 5	301 56 3	347 55 4	21
22	236	357 1 1	213 19 58	232 36 8	294	344 4 50	251 6 4	289 46 1	354	355 31 31	314 59 57	348 54 13	22
23	237	9 12 28	226 23 52	233 35 16	295	356 16 17	264 9 57	290 45 9	355	7 42 58	328 3 51	349 53 21	23
24	238	21 23 55	239 27 45	234 34 24	296	8 27 43	277 13 51	291 44 17	356	19 54 25	341 7 45	350 52 29	24
25	239	33 35 21	252 31 39	235 33 33	297	20 39 10	290 17 45	292 43 25	357	32 5 52	354 11 39	351 51 37	25
26	240	45 46 48	265 35 33	236 32 41	298	32 50 37	303 21 39	293 42 34	358	44 17 18	7 15 32	352 50 45	26
27	241	57 58 15	278 39 27	237 31 49	299	45 2 3	316 25 33	294 41 42	359	56 28 45	20 23 26	353 49 53	27
28	242	70 9 41	291 43 21	238 30 57	300	57 13 30	329 29 27	295 40 51	360	68 40 11	33 27 20	354 49 1	28
					301	69 24 56	342 33 21	296 39 59	361	80 51 38	46 31 14	355 48 9	29

Day.	9. PAUSHA. Ahar.	Distance ☾—☉.	☾'s Anom.	Long. ☉	11. PHÂLGUNA. Ahar.	Distance ☾—☉.	☾'s Anom.	Long. ☉	13. VAISÂKHA OF THE FOLLOWING SOLAR YEAR. Ahar.	Distance ☾—☉.	☾'s Anom.	Long. ☉	Day.
0	243	82° 21′ 8″	304° 47′ 15″	239° 30′ 5″	302	81° 36′ 23″	355° 37′ 15″	297° 39′ 7″	362	93° 3′ 5″	59° 31′ 8″	356° 47′ 17″	0
1	244	94 32 35	317 51 9	240 29 13	303	93 47 50	8 41 9	298 38 15	363	105 14 32	72 35 2	357 46 25	1
2	245	106 44 15	330 55 3	241 28 21	304	105 59 16	21 45 3	299 37 23	364	117 25 58	85 38 56	358 45 34	2
3	246	118 55 28	343 58 46	242 27 30	305	118 10 43	34 48 56	300 36 32	365	129 37 25	98 42 49	359 44 42	3
4	247	131 6 55	357 2 50	243 26 33	306	130 22 10	47 52 50	301 35 40	366	141 48 52	111 46 43	360 43 50	4
5	248	143 18 22	10 6 44	244 25 46	307	142 33 37	60 56 44	302 34 48	367	154 0 18	124 50 37	1 42 58	5
6	249	155 29 48	23 10 38	245 24 54	308	154 45 3	74 0 38	303 33 56	368	166 11 45	137 54 31	2 42 6	6
7	250	167 41 15	36 14 32	246 24 2	309	166 56 31	87 4 32	304 33 4	369	178 23 12	150 58 25	3 41 15	7
8	251	179 52 42	49 18 26	247 23 10	310	179 7 57	100 8 26	305 32 13	370	190 34 38	164 2 19	4 40 23	8
9	252	192 4 8	63 22 20	248 22 18	311	191 19 24	113 12 20	306 31 21	371	202 46 5	177 6 13	5 39 31	9
10	253	204 15 35	75 26 14	249 21 27	312	203 30 51	126 16 14	307 30 29	372	214 57 32	190 10 7	6 38 39	10
11	254	216 27 2	88 30 8	250 20 35	313	215 42 17	139 20 8	308 29 37	373	227 8 58	203 14 1	7 37 47	11
12	255	228 38 58	101 34 1	251 19 43	314	227 53 43	152 24 2	309 28 45	374	239 20 25	216 17 55	8 36 56	12
13	256	240 49 55	114 37 55	252 18 51	315	240 5 10	165 27 55	310 27 53	375	251 31 52	229 21 48	9 36 4	13
14	257	253 1 22	127 41 49	253 17 59	316	252 16 37	178 31 49	311 27 1	376	263 43 18	242 25 42	10 35 12	14
15	258	265 12 49	140 45 43	254 17 7	317	264 28 3	191 35 43	312 26 9	377	275 54 45	255 29 36	11 34 20	15
16	259	277 24 15	153 49 37	255 16 16	318	276 39 30	204 39 37	313 25 17	378	288 6 12	268 33 30	12 33 28	16
17	260	289 35 42	166 53 31	256 15 24	319	288 50 57	217 43 31	314 24 25	379	300 17 39	281 37 24	13 32 37	17
18	261	301 47 9	179 57 25	257 14 32	320	301 2 24	230 47 25	315 23 34	380	312 29 5	294 41 18	14 31 44	18
19	262	313 58 35	193 1 19	258 13 40	321	313 13 50	243 51 19	316 22 42	381	324 40 32	307 45 12	15 30 53	19
20	263	326 10 2	206 5 13	259 12 48	322	325 25 17	256 55 13	317 21 50	382	336 51 59	320 49 6	16 30 0	20
21	264	338 21 29	219 9 7	260 11 57	323	339 36 44	269 59 7	318 20 58	383	349 3 26	333 53 0	17 29 8	21
22	265	350 32 55	232 13 0	261 11 5	324	349 48 10	283 3 1	319 20 6	384	1 14 52	346 56 54	18 28 17	22
23	266	2 44 22	245 16 54	262 10 13	325	1 59 37	296 6 54	320 19 15	385	13 26 19	0 0 47	19 27 25	23
24	267	14 55 49	258 20 48	263 9 21	326	14 11 4	309 10 48	321 18 23	386	25 37 46	13 4 41	20 26 33	24
25	268	27 7 16	271 24 42	264 8 29	327	26 22 31	322 14 42	322 17 31	387	37 49 12	26 8 35	21 25 42	25
26	269	39 18 42	284 28 36	265 7 37	328	38 33 57	345 18 36	323 16 39	388	50 0 39	39 12 29	22 24 50	26
27	270	51 30 9	297 32 30	266 6 46	329	50 45 24	358 22 30	324 15 47	389	62 12 5	52 16 23	23 23 58	27
28	271	63 41 36	310 36 24	267 5 53	330	62 56 51	1 26 24	325 14 56	390	74 23 32	65 20 17	24 23 6	28
					331	75 8 17	14 30 18	326 14 4	391	86 34 59	78 24 10	25 22 14	29
									392	99 36 25	91 28 4	26 21 22	30

Table XXII.—*For Ghaṭikâs and Palas.*

gh. pa.	☾−☉. ° ′	″	‴	☾'s An. ° ′	″	‴	Long☉ ′ ″	‴	gh. pa.	☾−☉. ° ′	″	‴	☾'s An. ° ′	″	‴	Long☉ ′ ″	‴
1	0	12	11	0	13	4	0	59	31	6	17	55	6	45	1	30	33
2	0	24	23	0	26	8	1	58	32	6	30	6	6	58	5	31	32
3	0	36	34	0	39	12	2	57	33	6	42	17	7	11	9	32	31
4	0	48	46	0	52	16	3	56	34	6	54	29	7	24	13	33	31
5	1	0	57	1	5	19	4	56	35	7	6	41	7	37	16	34	30
6	1	13	9	1	18	23	5	55	36	7	18	52	7	50	20	35	29
7	1	25	20	1	31	27	6	54	37	7	31	3	8	3	24	36	28
8	1	37	32	1	44	31	7	53	38	7	43	15	8	16	28	37	27
9	1	49	43	1	57	35	8	52	39	7	55	26	8	29	32	38	26
10	2	1	54	2	10	39	9	51	40	8	7	38	8	42	36	39	25
11	2	14	6	2	23	43	10	50	41	8	19	49	8	55	40	40	25
12	2	26	17	2	36	47	11	50	42	8	32	1	9	8	44	41	24
13	2	38	29	2	49	41	12	49	43	8	44	12	9	21	48	42	23
14	2	50	40	3	2	55	13	48	44	8	56	24	9	34	52	43	22
15	3	2	52	3	15	58	14	47	45	9	8	35	9	47	55	44	21
16	3	15	3	3	29	2	15	46	46	9	20	46	10	0	59	45	20
17	3	27	15	3	42	6	16	45	47	9	32	58	10	14	3	46	19
18	3	39	26	3	55	10	17	44	48	9	45	9	10	27	7	47	19
19	3	51	37	4	8	14	18	44	49	9	57	21	10	40	11	48	18
20	4	3	49	4	21	18	19	43	50	10	9	32	10	53	15	49	17
21	4	16	0	4	34	22	20	42	51	10	21	44	11	6	19	50	16
22	4	28	12	4	47	26	21	41	52	10	33	55	11	19	23	51	15
23	4	40	23	5	0	30	22	40	53	10	46	7	11	32	27	52	14
24	4	52	35	5	13	34	23	39	54	10	58	18	11	45	30	53	13
25	5	4	46	5	26	37	24	38	55	11	10	29	11	58	34	54	12
26	5	16	58	5	39	41	25	38	56	11	22	41	12	11	38	55	12
27	5	29	9	5	52	45	26	37	57	11	34	52	12	24	42	56	11
28	5	41	20	6	5	49	27	36	58	11	47	4	12	37	46	57	10
29	5	53	32	6	18	53	28	35	59	11	59	15	12	50	50	58	9
30	6	5	43	6	31	57	29	34	60	12	11	27	13	3	54	59	8

Table XXIII.—*Names of Jupiter's cyclic years.*

No.	Cyclic year.	No.	Cyclic year.
0	Vijaya.	30	Rudhirodgârin.
1	Jaya.	31	Raktâksha.
2	Manmatha.	32	Krodhana.
3	Durmukha.	33	Kshaya
4	Hemalamba.	34	Prabhava.
5	Vilamba.	35	Vibhava.
6	Vikârin.	36	Śukla.
7	Sârvarî.	37	Pramoda.
8	Plava.	38	Prajâpati.
9	Śubhakrit.	39	Angiras.
10	Śobhana.	40	Śrîmukha.
11	Krodhin	41	Bhâva.
12	Viśvâvasu.	42	Yuvan.
13	Parâbhava.	43	Dhâtṛi.
14	Plavanga.	44	Îśvara.
15	Kîlaka.	45	Bahudhânya.
16	Saumya.	46	Pramâthin.
17	Sâdhâraṇa.	47	Vikrama.
18	Virodhakṛit.	48	Bhriśya,
19	Paridhâvin.	49	Chitrabhânu.
20	Pramâdin.	50	Subhânu.
21	Ânanda.	51	Taraṇa.
22	Râkshasa.	52	Pârthiva.
23	Anala.	53	Vyaya.
24	Pingala.	54	Sarvajit.
25	Kâlayukta.	55	Sarvadhârin.
26	Siddhârthin.	56	Virodhin.
27	Raudra.	57	Vikṛita.
28	Durmati.	58	Khara.
29	Dundubhi.	59	Nandana.

Table XXIV.—(*A*) *Equation of the Moon's centre.*

Arg: ☾'s Anomaly ☾'s Eq. —				Equation of the Moon's centre. *Sûrya Siddh.*			Δ′	*Ârya Siddh.*			Δ′	*2nd Ârya Siddh.*			Δ′	*Brah. & S. Śir.*			Δ′	Arg.: ☾'s Anomaly ☾'s Eq +			
0°	0′	180°	0′	0°	0′	0″		0°	0′	0″		0°	0′	0″		0°	0′	0″		180°	0′	360°	0′
3	45	176	15	0	19	59	5″·33	0	19	41	5″·25	0	19	44	5″·26	0	19	45	5″·27	183	45	356	15
7	30	172	30	0	39	52	5 ·30	0	39	17	5 ·23	0	39	23	5 ·24	0	39	25	5 ·24	187	30	352	30
11	15	168	45	0	59	31	5 ·26	0	58	43	5 ·18	0	58	50	5 ·19	0	58	53	5 ·19	191	15	348	45
15	0	165	0	1	18	54	5 ·17	1	17	52	5 ·11	1	18	2	5 ·12	1	18	7	5 ·13	195	0	345	0
18	45	161	15	1	37	53	5 ·06	1	36	41	5 ·02	1	36	53	5 ·03	1	36	59	5 ·03	198	45	341	15
22	30	157	30	1	56	25	4 ·94	1	55	3	4 ·90	1	55	19	4 ·92	1	55	26	4 92	202	30	337	30
26	15	153	45	2	14	29	4 .81	2	13	0	4 ·79	2	13	17	4 ·79	2	13	25	4 ·80	206	15	333	45
30	0	150	0	2	32	0	4 ·67	2	30	25	4 ·64	2	30	44	4 ·65	2	30	53	4 ·66	210	0	330	0
33	45	146	15	2	48	48	4 ·48	2	47	8	4 ·46	2	47	29	4 ·47	2	47	39	4 ·47	213	45	326	15
37	30	142	30	3	4	52	4 ·28	3	3	8	4 ·27	3	3	32	4 ·28	3	3	43	4 ·28	217	30	322	30
41	15	138	45	3	20	8	4 ·07	3	18	22	4 ·06	3	18	47	4 ·06	3	18	59	4 ·06	221	15	318	45
45	0	135	0	3	34	30	3 ·86	3	32	43	3 ·83	3	33	10	3 ·84	3	33	23	3 ·83	225	0	315	0
48	45	131	15	3	48	1	3 ·61	3	46	11	3 ·59	3	46	40	3 ·60	3	46	55	3 ·61	228	45	311	15
52	30	127	30	4	0	33	3 ·34	3	58	46	3 ·34	3	59	17	3 ·35	3	59	31	3 ·34	232	30	307	30
56	15	123	45	4	12	3	3 ·07	4	10	17	3 ·06	4	10	48	3 ·06	4	11	4	3 ·07	236	15	303	45
60	0	120	0	4	22	30	2 ·78	4	20	43	2 ·77	4	21	18	2 ·79	4	21	34	2 ·79	240	0	300	0
63	45	116	15	4	31	46	2 ·47	4	30	7	2 ·48	4	30	35	2 ·48	4	30	54	2 ·48	243	45	296	15
67	30	112	30	4	39	56	2 ·18	4	38	13	2 ·17	4	38	49	2 ·18	4	39	6	2 ·18	247	30	292	30
71	15	108	45	4	46	50	1 ·84	4	45	10	1 ·84	4	45	46	1 ·84	4	46	4	1 ·85	251	15	288	45
75	0	105	0	4	52	32	1 ·52	4	50	52	1 ·52	4	51	30	1 ·52	4	51	49	1 ·52	255	0	285	0
78	45	101	15	4	56	59	1 ·19	4	55	22	1 ·19	4	56	9	1 ·19	4	56	10	1 ·19	258	45	281	15
82	30	97	30	5	0	13	0 ·86	4	58	37	0 ·86	4	59	16	0 ·87	4	59	34	0 ·87	262	30	277	30
86	15	93	45	5	2	9	0 ·52	5	0	23	0 ·51	5	1	1	0 ·51	5	1	30	0 ·52	266	15	273	45
90	0	90	0	5	2	46	0 ·16	5	1	9	0 ·16	5	1	46	0 ·16	5	2	7	0 ·16	270	0	270	0

TABLE XXIV—continued. (*B*) *Equation of the Sun's centre.*

Arg. : Anomaly. ⊙'s eq. +		*Sûrya Siddh.*	Δ′	*Ârya Siddh.*	Δ′	*2nd Ârya, Brah, & Siddh. S'ir.*	Δ′	Arg. : Anomaly. ⊙'s eq. —	
0° 0′	180° 0′	0° 0′ 0″		0° 0′ 0″		0° 0′ 0″		180° 0′	360° 0′
3 45	176 15	0 8 44	2″·33	0 8 26	2″·25	0 8 32	2″·28	183 45	356 15
7 30	172 30	0 17 24	2·31	0 16 50	2·23	0 17 3	2·27	187 30	352 30
11 15	168 45	0 25 58	2·28	0 25 8	2·21	0 25 28	2·24	191 15	348 45
15 0	165 0	0 34 24	2·25	0 33 22	2·20	0 33 47	2·22	195 0	345 0
18 44	161 15	0 42 38	2·19	0 41 26	2·15	0 41 57	2·18	198 45	341 15
22 30	157 30	0 50 40	2·14	0 49 19	2·10	0 49 55	2·12	202 30	337 30
26 15	153 45	0 58 29	2·08	0 57 0	2·05	0 57 42	2·07	206 15	333 45
30 0	150 0	1 6 3	2·02	1 4 28	1·99	1 5 15	2·01	210 0	330 0
33 45	146 15	1 13 18	1·92	1 11 37	1·91	1 12 31	1·94	213 45	326 15
37 30	142 30	1 20 13	1·86	1 18 29	1·83	1 19 27	1·85	217 30	322 30
41 15	138 45	1 26 47	1·75	1 25 1	1·74	1 26 4	1·76	221 15	318 45
45 0	135 0	1 32 57	1·66	1 31 10	1·64	1 32 17	1·66	225 0	315 0
48 45	131 15	1 38 44	1·54	1 36 56	1·54	1 38 9	1·56	228 45	311 15
52 30	127 30	1 44 5	1·43	1 42 18	1·43	1 43 34	1·44	232 30	307 30
56 15	123 45	1 48 59	1·31	1 47 13	1·31	1 48 32	1·32	236 15	303 45
60 0	120 0	1 53 26	1·19	1 51 40	1·19	1 53 3	1·20	240 0	300 0
63 45	116 15	1 57 22	1·05	1 55 39	1·06	1 57 5	1·08	243 45	296 15
67 30	112 30	2 0 50	0·92	1 59 8	0·93	2 0 37	0·94	247 30	292 30
71 15	108 45	2 3 46	0·78	2 2 6	0·79	2 3 37	0·80	251 15	288 45
75 0	105 0	2 6 11	0·66	2 4 32	0·65	2 6 4	0·64	255 0	285 0
78 45	101 15	2 8 4	0·55	2 6 27	0·51	2 8 1	0·52	258 45	281 15
82 30	97 30	2 9 26	0·37	2 7 50	0·37	2 9 25	0·36	262 30	277 30
86 15	93 45	2 10 15	0·22	2 8 40	0·22	2 10 15	0·22	266 15	273 45
90 0	90 0	2 10 31	0·07	2 8 56	0·07	2 10 31	0·07	270 0	270 0

TABLE XXV.—*Latitudes and Longitudes of Places.*

PLACE.	N. Lat.	LONGITUDE. E. fr. Gr.	LONGITUDE. Time Diff. fr. Lankâ.
			gh. p.
Abu (Arbuda) .	24° 48′	72° 46′	—0 30
Agra .	27 10	77 59	+0 23
Ahmadâbâd .	23 2	72 32	—0 32
Ahmadnagar .	19 8	74 43	—0 10
Ajaṇṭâ . .	20 33	75 48	+0 1
Ajmer . .	26 28	74 37	—0 11
Aligadh . .	27 53	78 5	+0 14
Allahâbâd .	25 25	81 51	+1 1
Amarâvatî .	16 35	80 24	+0 20
Amritsar .	31 37	74 48	—0 9
Anhilwâḍ .	23 47	71 56	—0 40
Arkat . .	12 52	79 21	+0 37
Aurangâbâd .	19 52	75 20	—0 4
Ayodhya—Audh	26 48	82 8	+1 4
Bâdâmi . .	16 56	75 40	—0 1
Banâras . .	25 20	83 0	+1 13
Banavaśi .	14 34	75 2	—0 7
Bangalor .	12 57	77 35	+0 18
Bardhwân .	23 13	87 54	+2 2
Bârodâ . .	22 16	73 9	—0 30
Bârsî . .	18 13	75 40	+0 1
Belgaum .	15° 50′	74° 31′	—0 12
Bhâgalpur .	25 13	86 59	+1 53
Bharatpur .	27 12	77 27	+0 15
Bharoch . .	21 44	72 58	—0 28
Bhelsa . .	23 30	77 46	+0 21
Bhopal . .	23 14	77 20	+0 16
Bîjyanagar .	15 17	76 30	+0 8
Bijapur . .	16 48	75 44	+0 0
Bikaner .	28 1	73 18	—0 24
Bombay . .	18 57	72 51	—0 29
Bundi . .	25 26	75 37	—0 1
Burhanpur .	21 18	76 17	+0 7
Calcutta .	22 36	88 23	+2 8
Delhî . .	28 37	77 12	+0 15
Devagiri (Dhaul-tâbâd).	19 54	75 14	—0 6
Dhaka . .	23 45	90 23	+2 27
Dhârâ . .	22 35	75 16	—0 5
Dhârwâ . .	15 26	75 2	—0 7
Dholpur . .	26 40	77 53	+0 22
Dhulia . .	20 53	74 43	—0 10

TABLE XXV—*continued.*

PLACE.	N. Lat.	LONGITUDE. E. fr. Gr.	LONGITUDE. Time Diff. fr. Lankâ
			gh. p.
Dvârakâ .	22° 16′	68 58′	—1 11
Elura . .	20 2	75 1	—0 6
Farrakhâbâd .	27 23	79 35	+0 49
Gayâ .	24 46	85 2	+1 31
Ghâzipur .	25 35	83 34	+1 18
Girnâr . .	21 30	70 30	—0 52
Goa . .	15 27	73 53	—0 19
Gorakhpur .	26 44	83 23	+1 17
Gurkhâ .	27 52	84 28	+1 26
Gwalior .	26 12	78 7	+0 24
Haidarâbâd (Dekhan).	17 18	78 30	+0 28
Haidarabad (Sindh).	25 24	68 18	—1 14
Hardâ . .	22 18	77 2	+0 13
Hardwâr . .	29 55	78 7	+0 24
Hushangâbâd .	22 43	77 39	+0 19
Indor . .	22 41	75 46	+0 1
Jabalpur . .	23 9	79 58	+0 44
Jagannâthapurî	19 46	85 50	+1 41
Jalgaum .	20 25	74 33	—0 10
Jambu . .	32 44	74 49	—0 7
Jaypur . .	26 56	75 52	+0 1
Jhânsî . .	25 37	78 35	+0 29
Jodhpur .	26 19	73 2	—0 27
Jûnâgadh .	21 29	70 22	—0 53
Kalingapaṭam .	18 18	84 9	+1 23
Kalyan . .	19 13	73 10	—0 25
Kanauj . .	27 3	79 58	+0 41
Kanchi . .	12 50	79 44	+0 39
Kanhpur . .	26 28	80 19	+0 46
Katak . .	20 28	85 53	+1 42
Khambât (Cambay).	22 18	72 32	—0 32
Khâtmâṇḍu .	27 43	85 17	+1 36
Kochi (Cochin)	9 56	76 15	+0 4
Kolâpur . .	16 43	74 13	—0 15
Lahor . .	31 33	74 16	—0 14
Lakhnau . .	26 51	80 56	+0 52
Madhurâ . .	9 56	78 7	+0 23
Madras . .	13 5	80 17	+0 46
Maisur . .	12 18	76 40	+0 9
Mangalur .	12 52	74 50	—0 10
Mâṇdavî . .	22 56	69 24	—1 3
Mathurâ . .	27 28	77 41	+0 20
Mongîr . .	25 22	86 30	+1 58
Multân . .	30 13	71 26	—0 43
Nâgpur . .	21 8	79 5	+0 34
Nâsik . .	20 0	73 44	—0 20
Pandharpur .	17 39	75 21	—0 4
Patiyâlâ . .	30 20	76 5	+0 7
Pâtna . .	25 33	85 21	+1 35
Puṇâ . .	18 29	73 13	—0 18
Purniya . .	25 46	87 51	+1 58
Râmeśvaram .	9 15	79 30	+0 36
Ratnâgiri .	17 0	73 20	—0 34
Rewâ . .	24 32	81 18	+0 56
Sâgar . .	23 51	78 42	+0 30
Sahet Mâhet .	27 31	82 5	+1 2
Sambhalpur .	21 31	83 57	+1 21
Sâtârâ . .	17 41	74 1	—0 17
Ṣironj . .	24 6	77 38	+0 19
Solâpur . .	17 39	75 54	+0 2
Ṣomnâthpattan .	22 4	71 26	—0 43
Ṣrînagar .	34 6	74 55	—0 8
Srîrangapatanam	12 24	76 41	+0 10
Surat . .	21 10	72 32	—0 32
Tanjor . .	10 45	79 7	+0 34
Thâṇâ . .	19 13	72 57	—0 28
Travankor .	9 10	76 50	+0 11
Trichinapalli .	10 47	78 43	+0 29
Trivandram .	8 30	76 56	+0 11
Udaypur .	24 37	73 43	—0 20
Ujjain . .	23 9	75 43	0 0

TABLE XXVI.—*Showing the times of rising (in Asus or sixths of vinâḍî) in 10°—32° north latitude, or ullagna equivalents in Oblique Ascension.*

Sign.	Latitudes. 10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°
I & XII .	1544	1531	1518	1506	1492	1478	1466	1452	1438	1425	1411	1396
II & XI .	1693	1681	1672	1660	1650	1639	1627	1616	1605	1593	1582	1570
III & X. .	1893	1889	1885	1881	1876	1872	1867	1863	1857	1853	1848	1844
IV & IX .	1977	1981	1985	1989	1994	1998	2003	2007	2013	2017	2022	2026
V & VIII .	1897	1909	1918	1928	1940	1952	1963	1974	1985	1997	2008	2020
VI & VII .	1796	1809	1822	1834	1848	1862	1874	1888	1902	1915	1929	1944

Sign.	Latitudes. 22°	23°	24°	25°	26°	27°	28°	29°	30°	31°	32°	Chara.
I & XII .	1382	1368	1353	1337	1322	1306	1290	1274	1257	1241	1224	+130
II & XI .	1558	1546	1533	1521	1508	1496	1483	1469	1455	1439	1424	+ 5
III & X. .	1839	1833	1829	1823	1818	1812	1808	1801	1795	1789	1783	—135
IV & IX .	2031	2037	2041	2047	2052	2058	2063	2069	2075	2081	2087	—135
V & VIII .	2032	2044	2057	2069	2083	2094	2107	2121	2135	2151	2166	+ 5
VI & VII .	1958	1972	1987	2003	2018	2034	2050	2066	2083	2099	2116	+130

For the rule see above, §60.

In the column *Chara* are entered the *Asus* by which the equivalent in right ascension of the several signs differs from the minutes of each sign. This difference is combined with the ascensional difference in the above table. As the former difference, however, was first introduced by Bhâskara, the amount of *Chara* must be added to the equivalents in oblique ascension if the date calculated is previous to Bhâskara, A. D. 1150.